METAL INDUSTRY

14 FEBRUARY 1958

Metals from Russia

RUSSIAN tin is now tenderable against the standard contract on the London Metal Exchange. This announcement was made on Thursday of last week, following a meeting of the committee of the Exchange and a notice was later posted to state that brand H.O.3 produced by Novosibirski Tin Plant, Novosibirski, U.S.S.R., had been registered under class A.1 of the standard contract form, and that this brand will now constitute a good delivery. So far this brand has formed only a small proportion of known Russian tin exports and no appreciable increase in supplies is anticipated.

Behind this announcement, however, lies material for speculation as to the recent sudden surge of Soviet non-ferrous metal exports, particularly aluminium. Historically, Russia has not been an exporter of non-ferrous metals. Only manganese has been sold abroad in any quantity and in view of recent events the United States Government has been investigating this entry of the Soviet into the non-ferrous market. Washington believes the recent Soviet ventures have been primarily to pay for increasing imports from Western Europe. Russia's foreign sales of tin shot up abruptly last year, especially to the United Kingdom, West Germany and the Netherlands. It will also be remembered that the Aluminum Company of Canada Limited has applied to the U.K. Board of Trade for the imposition of an anti-dumping duty on imports into this country of unwrought aluminium originating in the U.S.S.R., a matter on which, as yet, no decision has been given. The question now arises as to the future movements of metals from Soviet sources. Total shipments of non-ferrous metals from Russia last year were not of any great magnitude but all the same were three to four times greater than the 1956 exports.

These increases in exports are all the more surprising because, according to the chairman of the Mining Section of the Soviet Non-Ferrous Metal Research Institute, the loading equipment at the mine face and the pneumatic mining and drilling equipment for non-ferrous ores is antiquated. He asks for the speedy introduction of new electrical equipment and of electric locomotives and trolleys to carry the ore to the pithead. Again, a Russian expert on enrichment processes states that treatment methods of this type used in the Soviet Union tend to be wasteful. This, he says, applies particularly to copper ore enrichment plants where modern equipment, though available, is being introduced far too slowly. In the smelting installations in general comparatively large quantities of valuable metal dusts are lost with the smelter gases because of lack of filtering equipment.

If, therefore, Russia is in a position to export non-ferrous metals from an admittedly handicapped industry, it is interesting to speculate what effect it will have on the world's metal markets when her industry is completely up-to-date. Speculation on how soon this will be achieved is also permissible but, considering her progress in other fields, it may well be sooner than might be anticipated.

Out of the MELTING POT

Still Growing

FOR some reason or reasons, the formulation of the dislocation theories of crystal growth has, as it were, deflected interest from the growth of the more mundane examples to quite a noticeable concentration on more exotic growths. Indeed, the time has already arrived when a qualified benefactor might be persuaded to present a survey of the development to date for the sake of the more general and, in particular the metallurgical reader who, while he may have been able to keep up with the growth of metal whiskers on metal surfaces, may find the growing of whiskers from the vapour phase, with or without intervening chemical reactions, a little more troublesome, and may, perhaps, miss altogether such undoubtedly relevant and most interesting work as the recent investigation of the growth and defect structure of sapphire microcrystals. These were formed by heating a small amount of aluminium or $TiAl_3$ (containing a small excess of aluminium) to between 1,300° and 1,450°C. in a stream of hydrogen at about 1 atmosphere, with a partial pressure of water of between $1{\cdot}2 \times 10^{-4}$ and $3{\cdot}6 \times 10^{-3}$ atmospheres for from two to 24 hours. Under these conditions, seemingly downy deposits of transparent and translucent crystals formed about the metal charges to distances up to 2 in. Embedded in these deposits of filamentary crystals of alpha alumina and sillimanite were needle- and plate-shaped single crystals of alpha alumina (sapphire). The needles ranged from 1 to 30 mm. in length, with hexagonal cross-sections measuring from 3 to 50 microns across, and often had rather sharp tips. The platelet crystals were from 0·5 to 10 microns thick and up to 10 mm. long. The growth axes of the needles lay in the (001) direction, while in the case of the platelets the large surfaces were perpendicular to this direction. Growth of these crystals is presumed to depend on the formation of aluminium monoxide (AlO), its volatilization, and subsequent condensation and decomposition on an Al_2O_3 surface. Growth takes place at the tips of the needles and at the edges of the platelets at steps formed by the intersection of screw dislocations with surfaces. In some bend tests, the needles were subjected to elastic strains of over 2 per cent, the largest strain observed corresponding to a strength of 1,700,000 lb/in^2, whereas the tensile strength of large single crystals of alpha alumina is about 45,000 lb/in^2.

Descent

GETTING down to fundamentals may be essential for progress to be made. What is equally essential, however, is that on all such occasions the excitement of making progress should not be allowed to push into oblivion the fact that it is being made in the downward direction. Unfortunately, this is only too often allowed to happen. Consider, for example, the growing development in connection with information retrieval, of an association between classification and certain types of electronic machines. While classification is still a little-understood function performed by the human brain, it has been cheerfully suggested that the great promise of these machines lies in the fact that the systems that they use will make possible the "conceptualization" of recorded information in patterns approaching those used in the corresponding process in the human brain. Furthermore, as we learn more and more about the operation of the brain we shall be able to build increasingly improved mechanisms for imitating and extending its functions, and, as we build improved machines, we shall undoubtedly learn more and more about the brain. At this early stage it is not difficult to perceive that the development envisaged above will proceed in one particular direction (namely, down to fundamentals) from a situation created by the vast essentially-mechanical growth of recorded information; a situation which, as such, has nothing to do with the functions of the human brain, which find themselves increasingly ill adapted to coping with it and which are, accordingly, handing the job over, as it were, to purely mechanical mechanisms. It may be argued that this is due to the brain being a poor mechanism. Admitted; but then it must also be realized that this shows up only because the brain finds itself in a situation not of its own direct creation, and to which it is not and cannot be adapted, and that, at the same time, the machines which are being developed to take over with such success would, in any other situation, prove to be extremely poor brains.

Sticky

ARE you stuck for a composition for cementing metal strain gauge elements to the surface of a metal object to be tested at high temperatures of the order of 400°-800°C.? The probability is that while you are not completely stuck, the stuff you are using is not really satisfactory. It most likely consists of a mixture of finely divided refractory material with a bonding material, such as an alkali silicate or phosphoric acid. In the former case you may be having difficulty in applying the paste in a uniform manner, and may be finding the drying and baking procedures that are required somewhat irksome. On top of this, the performance of the bond finally achieved is probably disappointing in regard to the thermal shock resistance, and its life is accordingly unduly limited. In the case of a composition based on phosphoric acid, while thermal shock resistance is rather better, the phosphoric acid tends to attack surfaces of the less corrosion-resistant metals and alloys, and the evolution of hydrogen plays havoc with the coating and its adhesion. You may even have heard it suggested that for really satisfactory results the steel or other corrodible surface should first be protected by a coating of, for example, nickel, a suggestion which you no doubt considered as an unduly elaborate counsel of perfection. All these troubles are avoided by the use of a high-temperature cement composition developed and patented by Bristol Aero-Engines Ltd., the characteristic feature of which is the presence in it of a corrosion inhibitor, namely, chromic acid. For the rest, the cement comprises an acid phosphoric binder (monoaluminium phosphate is preferred), a refractory filler material (silica), and a finely-ground suspension-promoting refractory substance (titanium dioxide) to prevent rapid settling down of the filler. A typical composition is prepared by dissolving 25 gm. of monoaluminium phosphate and 3 gm. of chromic acid in water to give 100 mL. of solution, to which are added 160 gm. of 200-mesh quartz or flint silica flour and 40 gm. of titanium dioxide, the mixture being treated in a ball mill for two hours to ensure thorough mixing.

Skimmer

NEW DIE-CASTING LAYOUT AT YALE AND TOWNE

Conveyorized Die-Casting Foundry

AS part of the general scheme of development, designed to increase production and quality, which was referred to briefly in the issue of METAL INDUSTRY, 4 October 1957, p. 298, The Yale and Towne Manufacturing Company, of Willenhall, Staffs., have recently completed a re-organization of their die-casting foundry and trimming shop. Based upon the installation of a "Fisholow" conveyor, the new layout and process sequence are designed to make the maximum use of available floor space, to eliminate handling of the work wherever reasonably possible, and to simplify the collection of scrap and its return to the furnaces for remelting.

The conveyor comprises a series of buckets designed to tip automatically as they pass certain limit switches set at various points along the track. Each bucket is equipped with a four-button control, upon the setting of which depends the point at which that particular bucket will be tipped. In this way, as the work traverses the shop it can be delivered automatically for a subsequent operation into the work tray alongside a press, drilling or tapping machine, or grinder.

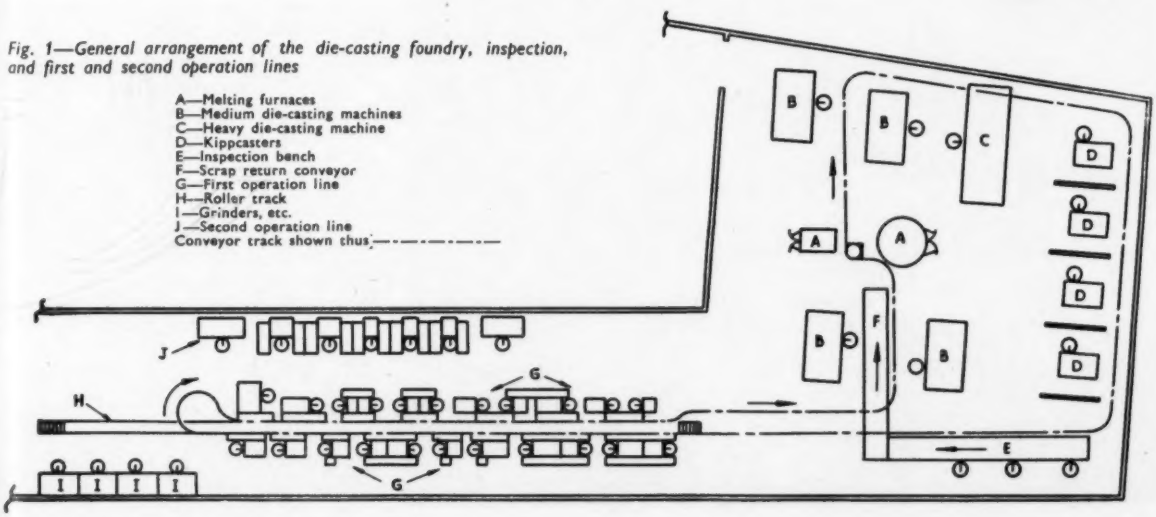
The arrangement of the die-casting foundry and its adjacent inspection, trimming and first and second operation lines is shown in Fig. 1. There are five die-casting machines producing the medium and larger castings. Four have been specially designed by Yale in America and are direct-air type, producing castings up to 2½ lb. (zinc), and one is a modern, fully automatic machine of British design with a capacity up to 10 lb. There are also four Kippcasters for the smaller die-castings. Metal for all machines is melted in two furnaces and fed from these to the pots of the die-casting machines. One furnace is of 800 lb. capacity and the other is 1 ton capacity. The Kippcasters are equipped with their own melting and holding pots.

Fig. 2—Two of the Yale die-casting machines, showing the conveyor dipping between them to a convenient height for the caster

It will be seen that the grouping of the die-casting machines has been arranged so that the conveyor passes each in turn. From Fig. 2 it will be apparent that the conveyor, which is at high level, dips to the level of the die-casting machines, thus making it easy for the machine operator to transfer castings into any passing bucket.

The conveyor speed is infinitely variable between 6 and 30 ft/min., and normally runs at 12 ft/min. Buckets are spaced at a pitch of 2 ft. 8 in., thus 4 buckets/min. pass each machine. Since average casting speed is 5 shots/min., this ensures that ample space is allowed on the conveyor for work in production, and a surplus of buckets is available for those components which cannot be handled immediately on the

Fig. 1—General arrangement of the die-casting foundry, inspection, and first and second operation lines



Left : Fig. 3—One of the Kippcasters, showing the conveyor at the rear and castings being transferred from pan to conveyor bucket

Above : Fig. 5—One of the stations on the first operation line, showing the roller table at the side of the machines

inspection or trimming lines to make one or more circuits of the track before being processed. The conveyor thus provides a simple "storage" system which occupies no floor space, nor does it involve any handling of loaded work pans.

After passing the five larger die-casting machines, the conveyor runs behind the row of four Kippcasters (Fig. 3). There the system used for loading the conveyor is a little different, since the work from the Kipp-casters is, in general, smaller than that from the other machines and is automatically ejected from the dies into a chute. For this reason work pans, open at one end, are provided, and castings first fall into these. When a work pan is reasonably full it is merely tipped-up at its forward end to discharge its contents into one of the conveyor buckets.

It should be pointed out here that the die-casters may deposit castings in any bucket which may be passing, since all work is sorted at the breaking-off station. There is one exception to this rule—every twelfth bucket is painted red and is reserved for small work from the Kippcasters.

After traversing the die-casting foundry and receiving castings from the die-casting machines, conveyor buckets pass to the breaking-off and inspection station. At this point (Fig. 4) one of three steps may be taken by the first girl on the inspection line. She may allow the bucket to trip and deposit its contents on to the table before her (this is the procedure followed in normal situations). Alternatively she may, by operating a switch beside her, cut out the trips and allow work to by-pass the inspection line for a further circuit of the conveyor track. Similarly, she may cut out the trip mechanism to allow work to pass direct to the second operation machines. This procedure is adopted for much of the work from the Kipp-casters which goes direct to presses for trimming, runners and flash being removed at the same time.

In principle, the flow of work is adjusted so that any handling is arranged to coincide with a further stage in the process. Thus, most of the work has to be inspected before trimming, piercing, drilling, etc. It is, therefore, convenient to break off runners at the inspection point, and to sort at the same time; one handling thus serves the three purposes.

As work is tipped on the inspection table in front of the first inspector, it is slid forward on to a belt conveyor, which carries it slowly past the row of inspectors. These girls break off the sprues and runners, examine the

Fig. 4—The inspection station. One of the conveyor buckets has just tipped its contents upon the inspection table

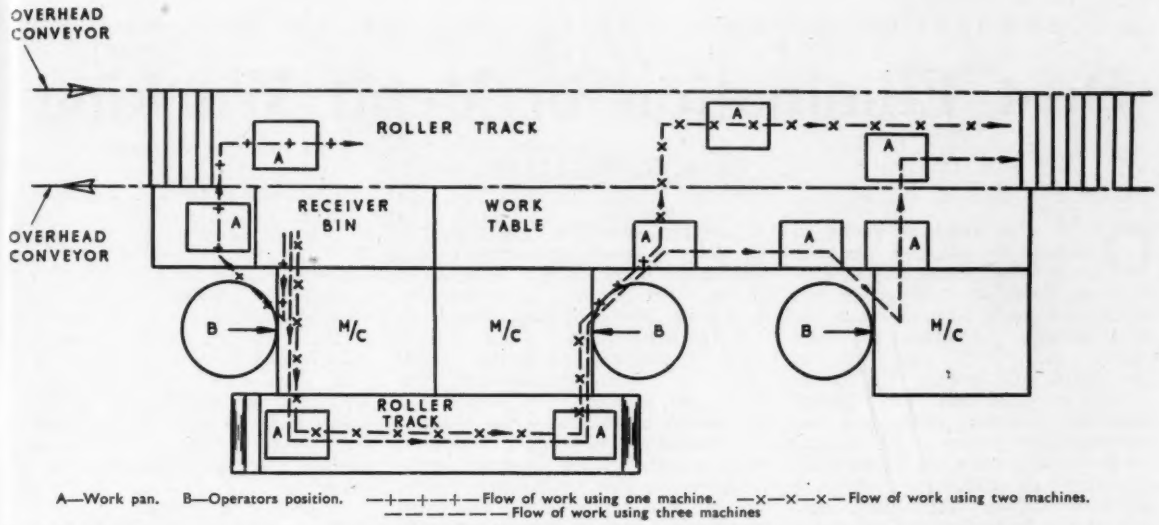

OVERHEAD CONVEYOR
ROLLER TRACK
RECEIVER BIN
WORK TABLE
OVERHEAD CONVEYOR
M/C
M/C
M/C
ROLLER TRACK
A—Work pan. B—Operators position. —+—+—+— Flow of work using one machine. —x—x—x— Flow of work using two machines. — — — — — Flow of work using three machines

Fig. 6—Diagrammatic arrangement of a section of the first operation line, showing the flow of work when one, two or three machines are used for successive operations on a particular component

components, and place them in a tray at shoulder level, appropriate to their type. From these trays they are returned to the conveyor buckets.

From the foregoing, it will be seen that as conveyor buckets leave the inspection station they may either (a) be empty, (b) contain sorted and inspected work, (c) contain work for direct transport to second operation machines, (d) contain unsorted work which is making a further circuit.

As each bucket passes the last inspector she re-sets its selector buttons according to a predetermined code so that it will tip next alongside the machine at which the first operation is to be carried out. Buckets passing through are, of course, set to neutral.

The first operation line is arranged along the two sides of the conveyor loop, and between the two rows of machines is a roller table. Work arrives via the conveyor and is tipped into the work pan on the left-hand side of the machine which carries out the first operation, which may, for example, be drilling. The operator takes a component from the left-hand work pan (at machine table level), carries out the appropriate operation, and places it in a pan on a short roller table to her right (Fig. 5).

When charged, this right-hand pan is rolled forward by hand to a further operator, who faces the first and who may be operating a tapper, and the left-to-right work transfer is again effected. The work then goes forward along the central roller table to linishing and grinding operations at the end of the line (Fig. 6).

The first operations are planned, as far as possible, to be carried out on two machines only (drill and tap; clip flash and drill, etc.) and to do this multiple press tools operating in two planes are frequently used.

At any of these first operation stations it is possible to change the machines quite quickly as the pattern of production varies. Thus, a small press and driller may be needed for certain components, a driller and tapper for others, and the necessary machines can easily be installed at any station.

As loaded work pans come from the first operation machines they are normally passed to backstand grinding machines or linishers, where any remaining flash and burr are removed (Fig. 7). The majority of castings then pass through to the polishing department for subsequent plating, but some are returned to the second operation machines for further machining.

Fig. 7—The linishing and grinding section. The end loop of the conveyor can be seen at top left

Titanium-Aluminium Alloys

IN some recent Russian work on the properties at elevated temperatures of pure titanium and of titanium-aluminium alloys with from 2·5 to 7 per cent aluminium content, in rod form, the following factors were investigated: (i) strength characteristics at 20°-550°C.; (ii) Vickers hardness at temperatures up to 1,000°C.; (iii) the effect of prolonged oxidation (100 hr.) at 350°-500°C. on mechanical properties; (iv) Brinell hardness at 200°-600°C. It was found that hardness increased with increases in aluminium content, according to *Metallovedenie i Obrabotka Metallov*. A tensile strength/Vickers hardness ratio of 1:0·28 was derived. Values for elongation fell with an increase in temperature from 300° up to 450°C., due to softening of the metal at these temperatures. As a result of their heterogeneous structure, ageing occurred at 400°-500°C. in alloys containing more than 5-6 per cent aluminium.

CONCENTRATION, PARTICLE SIZE AND COLLECTOR SYSTEMS

Dust Elimination in Metal Working

By A. E. WILLIAMS, Ph.D.

OVER a considerable period of years much attention has been given to the problem of air conditioning, both in commercial and industrial buildings, but so far as the metal-working industries are concerned, very little was done in this direction to reduce the hazards peculiar to these industries. Recent years have, however, witnessed a considerable improvement in the working conditions of metal workers, and while a full-scale air conditioning scheme is rarely attempted — this being considered both by workers and employers as unnecessary—some of the hazards which are associated with metal working have been removed by the continuous collection of metallic and non-metallic dusts at their source. Both smoke and fumes may also be collected at the same time, and this is a feature which is put to use, for example, when melting metals which may carry a film of oil or other material that vaporizes in the furnace. Examples of dusts are fine metallic particles arising from machining operations, while the non-metallic dust is usually sand and other moulding material associated with foundry operations.

Various systems and methods have been adopted for dust collection, embracing the use of centrifugal techniques, fabric filters, viscous and wet collectors, etc. In some installations, designed for a specific purpose, more than one of these methods may be in use. The chart, Fig. 1, devised by an American, S. Sylvan, outlines many dust control problems in terms of two important variables: concentration and mean particle size. The chart affords a means of estimating ranges of dust conditions encountered from typical dust-producing operations, and the data provide a guide for collector performance, while also furnishing an approximation of collection efficiency and mass mean particle size of material. Prediction of mass mean particle size is based on the particle size distribution slope for a material being the same on the inlet and discharge from collectors operating on the impaction theory, such as centrifugals, most wet collectors and fabric arresters. For collectors in the electrostatic group, the deviation slopes differ and the chart cannot be used to approximate the mean particle size of the dust. Since dusts found in practice rarely consist of particles of a given size, to define them one must specify not only the size but also the relative amounts of each size.

In order to estimate a size, and size distribution, of a dust, it is necessary to make a particle size analysis such as can be obtained with a series of sieves. For purposes of presenting, comparing, analysing or extrapolating particle size analysis in dust control work, logarithmic probability graph paper is commonly employed. On this paper, particle size is plotted on a logarithmic scale against the cumulative weight per cent, larger or smaller, than that size on an integrated probability scale. This plot frequently gives straight lines or lines of relatively small curvature. With this curve, the distribution function can be stated in terms of two parameters, the median size and the standard geometric deviation. The latter is expressed as the 84·13 per cent size divided by the 50 per cent size. Using these parameters in a mathematical function, the deviation lines shown on the chart have been computed for various types of industrial dusts.

To illustrate the use of the chart, and to show what type of collecting installation is required for a particular job, assume that the concentration and mean particle size of the dust created by a particular unit can vary between 3 and 10 grains/ft^3, with 5 to 10 microns range of mass particle size. Assume an inlet concentration of 7·5 grains/ft^3 and inlet mean particle size of 9 microns. Projection of this point vertically downward to the collection efficiency portion of the chart will indicate that a low resistance cyclone will be less than 50 per cent efficient. A high efficiency centrifugal will be between 60 per cent and 80 per cent efficient, and a wet collector, fabric filter, and an electrostatic precipitator will be over 97 per cent efficient. The latter three types of collectors are often preceded by a precleaner, so a high efficiency centrifugal would be selected. Using the average line of this group, the efficiency is 70 per cent, therefore the effluent from this collector will have a concentration of 7·5 (1·00−0·70)=2·25 grains/ft^3. A line is now drawn through the initial point with a slope parallel to the lines marked "industrial dust." Where deviation is not known, the average of this group of lines will normally be sufficiently accurate to predict the mean particle size in the collector effluent. Where this line intersects the horizontal line marked 2·25 grains/ft^3, a vertical line through the point will indicate the effluent mean particle size of 6·0 microns. A projection of this point of collector effluent vertically downward shows that a second high efficiency centrifugal will be less than 50 per cent efficient. A wet collector, fabric arrester, and electrostatic precipitator will be not less than 93 per cent efficient. Selection of a good wet collector will show an efficiency of 98 per cent. The effluent leaving this collector will have a concentration of 2·25 (1·00 — 0·98) = 0·045 grains/ft^3. Using the line initially drawn, at the point where it intersects the line of 0·045 grains/ft^3, will indicate a mean particle size in the effluent of 1·6 microns.

Collector Systems

The essentials of a dust control system are enclosures or hoods at the source of dust, piping to convey the dust-laden air, an exhauster to draw the dust from the source, and a separator to remove the dust from the carrier air. In modern types of dust collector these separate items of plant are often incorporated in one unit, which performs the duties of exhausting, separating and storing the dust. Compact designs also enable the collector to be installed near the source of dust, so saving long lengths of ducting.

While the basic pattern of collector may be the same for many different operations, the hoods which enclose the upper area of the source of dust may be of various designs, which are based primarily on the degree to which the dust source can be enclosed. The number of square feet of opening through which an incoming air current has to be maintained, and the selection of the necessary draught velocity to prevent escape of dust, will determine the volume of air to be exhausted for each operation. Sizes of branch and main air ducts are readily calculated by selecting the velocity necessary to convey the dust. The air volume in ft^3/min. divided by the required velocity in ft/min. gives the cross-section of the duct needed for that particular job. The collector must be of sufficient size to exhaust the required volume of air with reasonable horsepower. In the case of centrifugal or rotary type collectors, the speed of rotation will be a function of the pressure losses to be overcome in the system. An error of 10 per cent in pressure loss calculations will cause a variation of approximately 5 per cent from calculated exhaust volumes.

A typical layout for a small size works is given in Fig. 2, wherein a "Roto-Clone" collector is used, and the units to be exhausted are: a metallizer spray booth with face opening 3 ft. by 3 ft.; a 53 in. vertical spindle disc

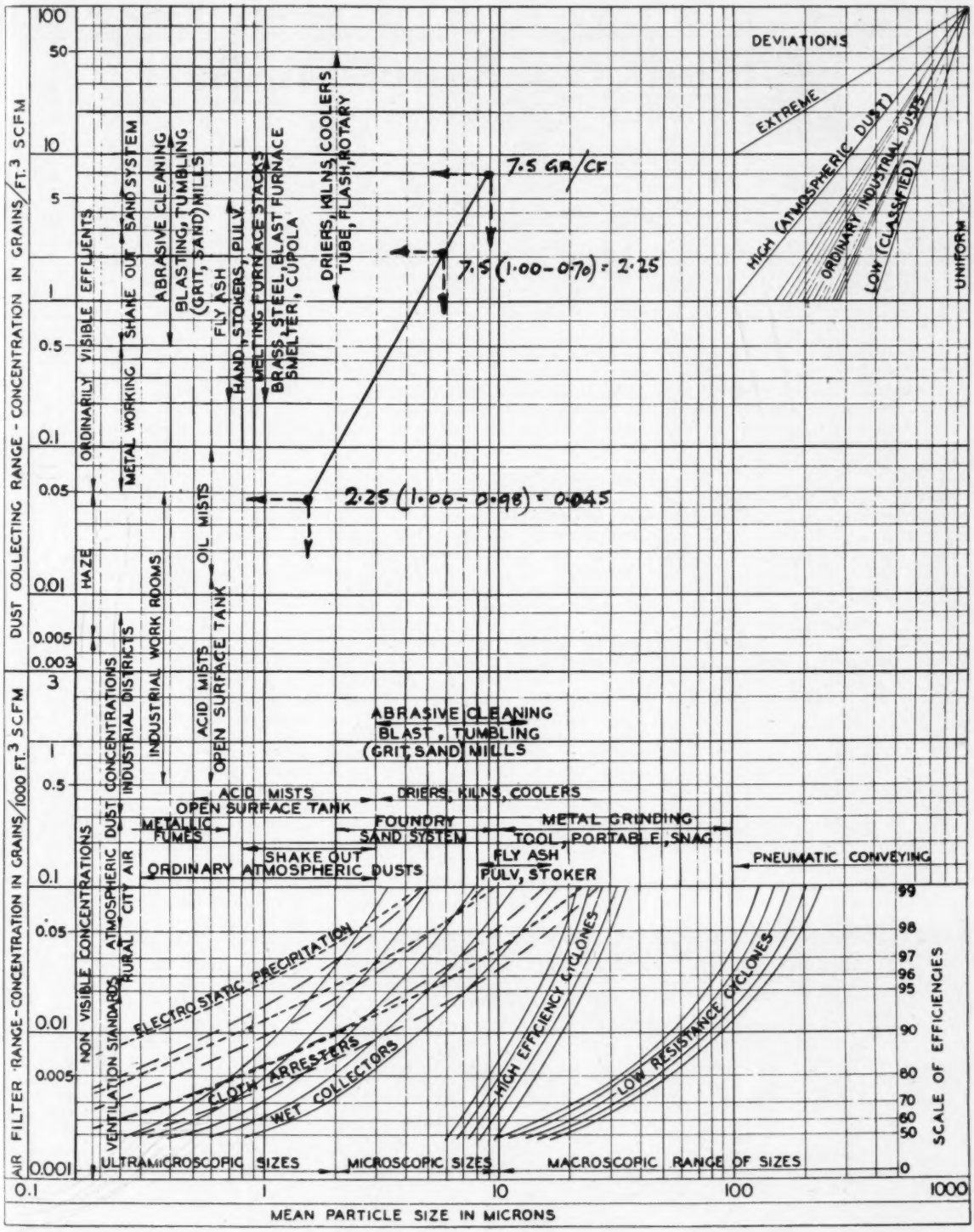
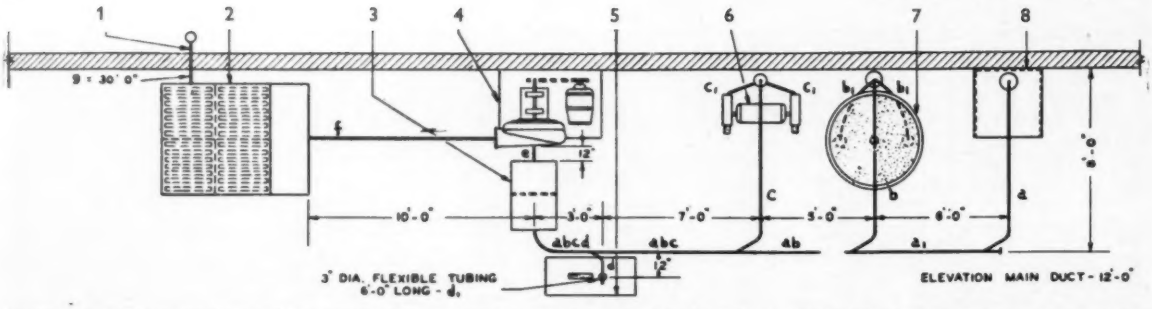


Fig. 1—The Sylvan chart, showing range of particle sizes, concentration and collector performance [Courtesy American Air Filter Co. Inc.

grinder; a two-wheel grinding stand, 20 in. by 2 in. wheels; and a surface grinder with 6 in. wheel. The first step in designing a dust control system is to determine the exhaust volume and branch pipe size required for each dust source, beginning with the one furthest away from the collector. The spray booth requires an exhaust volume of 1,800 ft³/min.; the disc grinder needs 1,760 ft³/min.; the grinding stand, 1,220 ft³/min.; and the surface grinder 225 ft³/min., making a total exhaust volume of 5,005 ft³/min. The various branch ducts are connected to a main duct, located to give only a short run to the collector. When practicable, branches having the



1—Discharge stack 9: extend above roof line, equip with weather hood. 2—Fabric collector, airmat or cloth. 3—Trap for large pieces or skimmer precleaner for heavy abrasive dust concentrations. 4—Roto-clone or exhauster. 5—Surface grinder, one 3 in. branch at 4,500 ft/min. = 225 ft³/min. 6—Two 20 in. × 3 in. grinding wheels, two 5 in. branches at 4,500 ft/min., 610 ft³/min. each = 1,220 ft³/min. 7—53 in. disc grinder vertical spindle. Two 6 in. branches at 4,500 ft/min., 880 ft³/min. each = 1,760 ft³/min. 8—Metallizer spray booth 36 in. × 36 in. face at 200 ft/min. = 1,800 ft³/min. 10 in. branch at 3,300 ft/min

Fig. 2—Typical layout of a dust collecting installation for a grinding and spraying shop [Courtesy Air Control Installations Ltd.

greatest resistance should be of the shortest possible lengths and should enter the main duct as close to the collector as possible. After installation of the system, the exhaust volumes may be regulated, as required in each branch duct, by the use of baffles or blast gates.

Exhaust volume requirements are calculated for normal temperatures and pressures, which assume that the density of air is 0·07488 lb/ft³. Where any appreciable variation in standard conditions occurs, the alteration of air density has to be taken into consideration. A centrifugal type exhauster connected to a given system will exhaust the same volume regardless of air density; the weight of air moved, however, will be a function of the density, which, in turn, is affected by temperature. Pressure developed in the system and the power used in operating the collector are governed by the temperature and density of the air being circulated. If a collector is capable of moving 10,000 ft³/min. of air at normal temperature, it will still move the same volume of hot air, but the volume will be considerably reduced when the temperature of the air returns to normal; this could result in a greatly reduced inflow of air at the dust source.

Collector Design

The rotary type of collector is similar in appearance to a pressure blower, but in the case of the "Roto-Clone" (Fig. 3) it is entirely different in principle. This unit is made up of two components, the impeller and a specially-designed housing. The latter provides two air passages, the primary passage through the scroll for the cleaned air and the secondary passage into the annular dust chamber which is connected to a dust hopper through cored ports in the base of the unit. The turbine-like impeller has a large number of carefully calculated hyperboloid blades, attached radially to a concave base having a centre cone to streamline the air flow. The rotation of this impeller creates the necessary force to draw in the dust-laden air at high velocity, and causes it to turn through an arc of almost 180° before entering the outlet scroll. The heavier dust particles are impinged upon the impeller disc, while the lighter particles are intercepted by the advancing surfaces of the blades. Both light and heavy particles move outwards by centrifugal force and converge at a point on the outer edge of the impeller. The paths of lighter particles, regardless of their location on the blade, intercept this point due to the contour of the blade.

Directly opposite this point of concentration is a narrow annular opening through which the particles are projected at high velocity into the dust chamber. The blade tips extending into the dust chamber create a secondary air circuit, which conveys the collected dust through a port in the base of the housing to the hopper below. This airtight hopper serves as a settling chamber, in which the reduced air velocity permits the entrained dust to settle out of the secondary air stream. Where the dust has a market value, as in the case of certain metal particles, these can be recovered for remelting. The secondary air then returns to the dust chamber through a return air port to be recirculated. This secondary air is not taken from the main air circuit, but is a closed supply in which the same air is used repeatedly. The cleaned air which forms the primary circuit passes into the scroll, from which it is exhausted outdoors, or, when desired, is recirculated into the workshops through a suitable final cleaner. These rotary collectors have the performance characteristics of a forward curved blade fan, and the operating range of a medium pressure exhauster; the relation of pressure, air volume and h.p. follow the standard rules of fan performance. In some applications the collector may be a central unit serving a number of different machines, as in Fig. 2, or, where a considerable amount of dust is likely to be created, it may be connected to a single machine, as in Fig. 3, where one collector is serving one swing frame grinder.

(To be concluded)

Fig. 3—Dust collection by the use of booth-type exhausts for swing frame grinders [Courtesy American Air Filter Co. Inc.

Research Progress

Grain Boundary Melting

BY RECORDER

METALLIC materials, as usually encountered in practice, consist of distinct grains of differing orientations separated from each other by relatively narrow regions that generally behave somewhat differently to the grains themselves. In particular, the effect of etching reagents indicates that some dissimilarity either of composition or energy level promotes a more rapid removal of material from these boundaries than from the grains. When the lattice structure of metals had been demonstrated, it was clear that the neighbouring crystals could not "match" at the boundaries except in special cases, and that these regions would, therefore, be disordered compared with the regular lattice array.

For some time the idea was held that grain boundaries consisted of a layer of "amorphous" material interposed between the grains, but a rather more clear-cut and lucid picture of the boundary structure has emerged principally as a result of the development of dislocation theory.

As grain boundaries indicate not only changes in orientation within the body of the metal but also the presence of certain types of defects, their effect on many properties of the material is considerable. The behaviour of grain boundaries is thus important, particularly in their influence on creep performance and when affected by "equilibrium segregation" of solute or impurity atoms.

Melting Point

In 1940, Chalmers reported that grain boundaries in tin bicrystals melted at 0·14°C. lower than the bulk of the metal. This melting point depression was apparently independent of the rate of heating, the stress across the boundary and the orientations of the two crystals. It was also unaffected by changes in impurity levels, and Chalmers therefore concluded that it was an intrinsic property of the boundary. Subsequent researches on aluminium suggested that grain boundaries in this metal also melt at a slightly lower temperature than the bulk material, though the values obtained varied appreciably. Recent work on the subject by F. Weinberg and E. Teghtsoonian[1] in the Department of Mines and Technical Surveys, Ottawa, has cast some doubt on these results, however, suggesting that if indeed the effect does exist it is very much smaller than has been thought previously.

In their apparatus, Weinberg and Teghtsoonian heated tin bicrystals at rates between 0·25° and 2·5°C/min. (this range is stated elsewhere in the Paper to have been 0·1-3·0°C/min.) under stresses of 50 to 6,000 gm/cm^2. The boundary between the crystals was arranged to be perpendicular to the applied stress, and the orientation of the two crystals was varied to give differences in angle of orientation across the boundary of 5° to 80°. The temperature, measured by thermocouple in a tin block close to, and in good thermal contact with the specimen, was raised at a constant rate by heat transfer through a large copper mass surrounding the assembly. Preliminary tests indicated that the temperature in the assembly was uniform and the accuracy of measurement was believed to be 0·02°C.

Under the above conditions, appreciable melting in the specimen was marked by the fall of the weight supplying the imposed load. Within the limits of stress used, some melting always occurred before separation in the specimen took place, though the time between the attainment of the melting temperature and this separation decreased as the stress was increased. The magnitude of the load did not affect the melting temperature.

Orientation Angle

When the tests had been completed, examination of the specimens revealed that separation on melting always occurred at the grain boundary provided the orientation angle across the boundary was 13° or more. When this angle was 11° or less, failure occurred away from the boundary in all cases, and no indication of melting or separation at the boundary could be detected.

Most of the above results were obtained in material containing 99·996 per cent tin, in which iron was the major impurity. Generally similar results were given by specimens of 99·9999 per cent tin containing of the order of 0·00001 per cent each of iron and lead, but here the difference in behaviour between "low-angle" and "high-angle" grain boundaries was found to lie at a slightly higher value (in excess of 13°). In all these tests the evidence indicated that if any difference in melting point between the grain boundary and the bulk material existed, it was within the experimental error, i.e. less than 0·02°C.

The effect of impurities was studied further in tin of 99·986 per cent purity to which additions of up to 0·1 per cent lead, of 0·04 per cent antimony, or of 0·05 per cent cadmium were made. These additions give rise to a slight freezing range, lead and cadmium giving a liquidus and solidus that fall with increasing concentration of the impurity, and antimony giving a rising liquidus and solidus. In the very dilute alloys tested, the lead and cadmium additions will tend to lower the melting "point" and, if concentrated at the grain boundaries, would be expected to cause abnormal premature failure at the boundary: for antimony an opposite effect would be predicted, and grain boundary separation should be inhibited if segregation of this element occurs at the boundary.

Assessment of Results

The experimental details given in the Paper relating to the testing of these very dilute alloys must be regarded as being rather unsatisfactory. For instance, the claim made for accuracy of temperature measurement is reduced for some unexplained reason from 0·02° to 0·05°C., though no mention is made of any significant change in technique. Further, and more serious, no information is provided about the grain boundary angles in the alloy bicrystals, so that one does not know whether or not the angle was the same in all the tests, nor whether it was in the range giving boundary separation in pure tin or at a low value that would not give boundary separation in the basis metal. Be that as it may, the authors report that, in fact, all the impure specimens did separate at the grain boundary, the temperature of failure varying with the amount and nature of the addition, and also with the level of imposed stress.

For lead stressed at 2,000 gm/cm^2 the differences in temperature between the point of separation in the alloy and the bulk melting point of the pure material were 0·1°, 0·4°, 0·65° and 1·10°C. for additions of 0·007, 0·02, 0·043 (given as 0·43 per cent in the Paper) and 0·10 per cent respectively. As expected, the lead additions reduced the temperature at which separation occurred, the solidus temperatures for the above alloys being estimated from the phase diagram to be 0·15°, 0·45°, 0·90° and 1·10°C. respectively below the melting point of pure tin. The depression caused by an addition of 0·043(?) per cent lead varied with stress, being 0·20°, 0·40°, 0·65° and 0·75°C. with imposed stresses of 100, 1,000, 2,000 and 4,000 gm/cm^2 respectively. It will be noticed that even at the highest stress the depression did not exceed the difference between the melting point of pure tin and the estimated solidus temperature. Similar features were observed with the other lead

(*Continued on page* 136)

Presentation of Metallurgical Information

By J. W. JENKIN, Ph.D., B.Sc., F.R.I.C., F.I.M.
(*Director of Technical Information, Tube Investments Ltd.*)

(*Concluded from* METAL INDUSTRY, 7 *February*, 1958)

Dealing with the spoken word in imparting metallurgical information, this concluding part of Dr. Jenkin's article touches on some of the difficulties which beset lecturers and their audiences, and suggests some of the ways in which a lecturer may make himself more readily understood.

THE written word is but a form of recorded speech. The spoken word comes first and we speak several times as fast as we write. Much of our time is spent in conversation in the works or the laboratory or the office. Amongst those we know best there is no call for the niceties of expression as long as we make ourselves understood and don't waste the other fellow's time. It is when we have to attend a meeting of several people, particularly if senior persons are present, that we tend to get a little anxious. All of us feel nervous at times, and I know of no cure or camouflage except self-control and a knowledge of what we want to say. The more persuasively or informatively we have to talk, the more importance attaches to adequate preparation and knowing one's audience. Whenever we can, we should be thinking a sentence ahead of the one we are saying, or at any rate we should not start a sentence without knowing how it is going to end. There are remarkable and clever people who can speak *ex tempore* without any apparent preparation, but for most of us the only hope of making a good impression is to work out beforehand exactly what we are going to say. Now in conversation that is practically impossible, and the only hope lies in quick thinking. None of us likes to appear stupid, but metallurgists are a generous and tolerant lot, and I do not think any of us need be afraid of each other as long as we speak clearly about what we know. We must of course be brief and courteous; by "brief" I mean not necessarily short on a time scale, but terse and concise. I have no doubt that training helps, just as practice improves.

The most exacting form of the spoken word in metallurgy is undoubtedly the lecture. Whether it is easy or difficult depends a lot upon the occasion and the audience. Speaking to the lay public can be the most difficult of all, because one cannot assume any detailed knowledge. There is also a great risk of misunderstanding because of the metallurgist's habit, to which I have already referred, of attaching specialized meanings to common words. An audience of experts can also be frightening, but only because they are metallurgists and know some of the language. If they knew as much as the lecturer does of his particular subject the chances are that they would not come, unless the occasion be some special one or the speaker a person of high reputation as a lecturer. The story is told of a young subaltern who was detailed to lecture to a refresher course for officers, and found himself confronted by a forbidding array of major-generals, brigadiers, colonels, majors, and captains. So he started off "Gentlemen, there are ten thousand people in the British Army who know a lot more about this subject than I do, but I don't see any of them here this morning so I'm going right ahead!" It is only when you stray outside your field of specialized knowledge that you need be consumed with unutterable nervousness.

Assuming however that a metallurgist is talking on a subject he knows all about, his lecture may still be a disappointment. The basic trouble is that none of us can see and hear ourselves as others do, without a lot of expense. It follows that I may fail lamentably to illustrate what I mean, but all the points I am going to mention here have in fact happened to me as a listener.

I must suit my speed to the size of the audience. If I speak as rapidly as I might do in conversation with one other person (*here Dr. Jenkin spoke very rapidly indeed*) you would not find it so easy to follow even if you heard what I said. On the other hand if I spoke as slowly as I would need to were I addressing three thousand people in the Town Hall, with appropriate pauses to ensure that I was understood (*here Dr. Jenkin spoke extremely slowly*), you would get tired before I should. The acoustics of the room can of course play a vital part. The large hall generally demands amplification, but in most metallurgical gatherings the speaker starts with a handicap if he cannot make himself heard at the far end of the room without a microphone. It is no bad idea to look at the chap who has come in late and had to sit at the back, and imagine he's a bit deaf; if you talk to him (without always looking at him) everybody else will hear all right. Microphones can be uncertain things: one never knows how much amplification there is, or when they will let you down. Even when a microphone works consistently the result can be uncertain unless the lecturer keeps close to it or carries it about with him. Even so, a constant distance is no guarantee of success, for memory recalls one lecturer who knew his subject well, spoke confidently without notes, and did not wander too far from the microphone, but listening to him was a trial (especially from the back of the room) because the intensity of his voice varied most disconcertingly. Sometimes a single syllable, or word, or group of words, would be sandwiched between almost inaudible sounds. In the end somebody shouted "Speak up!" but the result was merely to increase the intensity of his voice proportionately and the wild variations remained. I do not think for a moment that he realized the excessive contrasts he inflicted upon us.

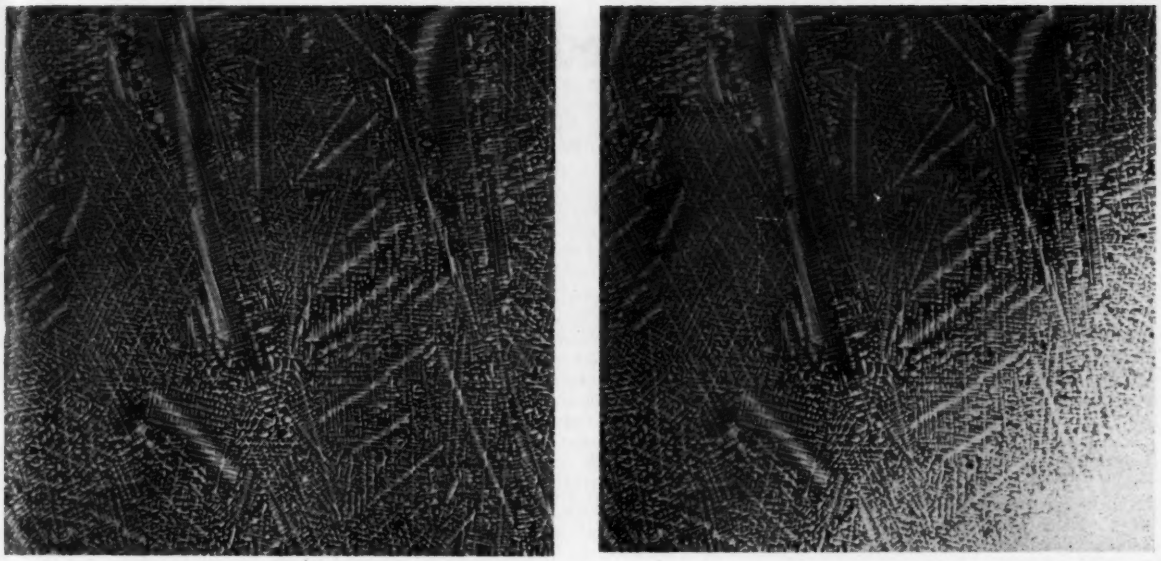
I wish I could mimic the Yorkshire dialect. If I could, I would tell you the story of the young speaker at a political meeting who was so nervous and inexperienced that his voice was almost inaudible. The more he realized it, the hotter he became about the collar, but try as he would he failed to make his voice carry. As might be expected, there was soon a cry from the back of the room "Speak up!" There being no improvement the shout was repeated, "Speak up!" At the third demand a man in the front row could stand it no longer, so he got up, turned round, and said "Thee shut up! Th'art missin' nowt!!"

Although we would all agree that the excessive use of the open vowel sound—er—can be—er—disconcerting, even the most eminent metallurgists are—er—prone to it. I suppose it is a sort of pause while one is trying to—er—think of the next word. If you have to stop to think, think silently, as long as you avoid the effect that was inflicted on us by one lecturer whose words came out not in an even flow but—in blocks of several—as if—the whole manuscript was sprinkled — with commas.

Many of these features amount to idiosyncrasies of the particular speaker, and I must not quote too many for fear of being slanderous. Some of us are so fond of particular words that we work them to death, unless some frank friend has the heart to tell us. Sometimes it is a phrase, like that used by a lecturer at one of our refresher courses about half a dozen times in the hour: "I'll return to that later."

I recently attended a meeting presided over by an eminent scientist who at the end of the proceedings was thanking the lecturer of the evening. His remarks were *ex tempore*, for he had no need of notes and there were in fact none on the table in front of him, but as he spoke he kept alternating his gaze fairly rapidly between the empty table and the far top left hand corner of the room. So it became distracting to watch him and I longed to turn round and look up into that corner to see what was there.

Undoubtedly the best lecturers are



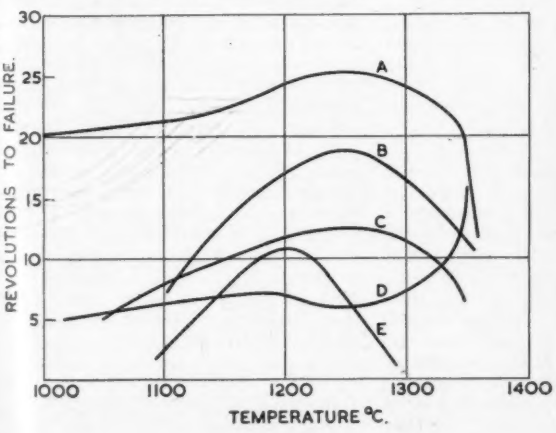
Cast microstructure, illustrating the visual effect of the light from the lectern casting an area of "fog" over the screen

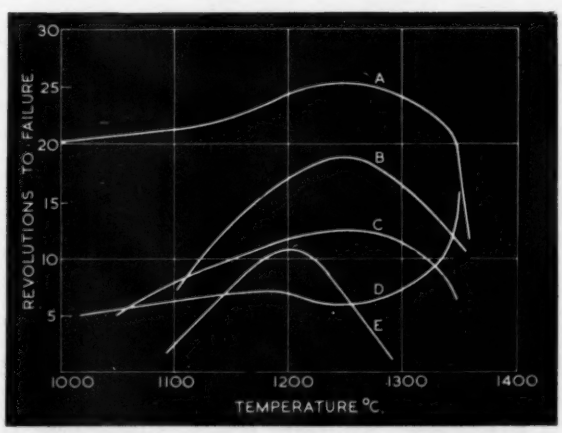
those who can speak clearly and entertainingly without any notes at all. It is better however that a lecturer should read his script if there is any danger of incoherence should he depart from it, which is why I am reading this now. Such a script must however be written to be heard and not for what it will look like in cold print. The lecturer who does not know his manuscript thoroughly, however, can create a most awkward pause if on returning from a brief period away from it he cannot find his place. The same may apply if he is picking up or putting away a pointer.

Most metallurgical lectures are illustrated by lantern slides, and it goes without saying that facilities must be good. The projector should be at the back of the room, that is, nobody should be likely to have his view of the screen obstructed. For a room that is longer than it is wide, the focal length of the apparatus should in my opinion be such that the distance of the projector is not more than about five or six times the width of the screen. Otherwise there is a danger that the picture will be too small for detail to be seen from the back, even if one applies the old criterion that a legend on a slide must be easily read ("with glasses if worn," as the saying is) when the slide is held in the hand. It is surprising how many slides fail on this score of boldness and simplicity. I recall one lecturer whose every slide was so full of detail that it was impossible to read even from the front row and he excused himself by saying that he merely put eight or nine such slides on the screen to show what an enormous mass of data had to be collated to draw the conclusions he gave us. This therefore meant that he need not have shown us any slides at all. The audience must not have to do much reading while they listen. I know it is impracticable, but I sometimes think it would be a salutary experience for a lecturer to operate his own lantern. Not only would he then know how easy or difficult his slides were to see, but he would have to describe them without using the pointer in the hand.

Some of our friends insist upon talking to the screen instead of to us. Even a turn of the head may cause inconvenience to some part of the audience, and requires a higher intensity of voice, not a higher pitch. Worse still, I have known lecturers walk to the screen, away from their scripts, and talk to the picture with their backs to the audience. It is surprising how often speakers allow a slide to remain on the screen long after they have finished talking about it. One of them even had the habit of looking at a picture, indeed talking to it, and speaking about something else. How he managed to talk about the mechanical properties of platinum while looking at a palladium-sulphur equilibrium diagram I don't know. As long as anything is on the screen in a darkened room everybody will look at the picture whatever the lecturer is talking about. I have even known a lecturer talk to a completely

Diagrams illustrating the relative visual impression created by a black-on-white and a white-on-black slide





blank screen instead of to his audience. Do let us have the lights up unless the speaker is actually talking about what we can see. In this connection I wish it were more prevalent to dim or raise lights through a resistance, for if a lecturer merely gives an inaudible signal to the lanternist to switch the lights up, instead of asking him orally, the audience is suddenly blinded without warning and therefore distracted for a time.

A fault that is surprisingly common is that the light from the reading desk fogs one corner of the screen, or if not the lectern light then a reflection of it from a nearby wall. It may not always matter with line drawings, but if I put on a photomicrograph carrying much detail, like one of a cast structure, there may be considerable loss in one of the lower corners. Probably many of you have given or attended lectures when there has been no reading desk at all. This can be very disconcerting to a lecturer who relies upon his manuscript, for he cannot see it if he is standing at a table of normal height, and he cannot very well hold it in his hand for an hour. Sometimes the usual position of the lectern is much too high, so that our shorter lecturers have been nearly out of sight and have seen little of us, or else like taller lecturers they have stood to one side and risked the disadvantages that follow the turning of the head. The lectern should be in front of the speaker and at the maximum distance that his eyes permit.

In my listening experience the technique of the use of the pointer leaves much to be desired. If it must be used, it must actually touch the screen. If it doesn't, then different members of the audience will necessarily see the end of the pointer against different parts of the screen, and not against what the lecturer sees. Once upon a time one of our friends could not find the pointer, so he walked away from his microphone to the screen, only to find that he could not reach what he wanted to point at. So his hand had to be quite a distance away from the screen as he pointed to something out of his reach, and none of us quite knew what he was pointing at. Another disconcerting thing is that some lecturers will wave the pointer in front of the screen while they are talking; if it is not touching something on the screen, it should be out of the way. A pointer fails if the line drawing is white on black; this is a limitation to the use of this sort of slide, which admittedly is less glaring than the usual black on white. The difficulty can be overcome by the use of an illuminated arrow manipulated by the lecturer, as is done at the Institution of Mechanical Engineers and at the Royal Institution in London. A slide showing white on black has, however, the great advantage that a line drawing can be coloured so that several interlacing curves can be clearly distinguished.

On the use of colour, the preparation of transparencies on 35 mm. film is now so easy that I think we may expect to see more of it on subjects where colour gives a much more realistic impression than monochrome. Things were very different 30-odd years ago when I wanted to illustrate the phases formed when copper and zinc diffuse into each other. I attempted a transparency on glass and proudly showed it to Professor Desch. His only comment was a bit crushing: "What a pity to waste a colour slide on such a scratchy specimen." On suitable subjects, however, a colour film does help to direct attention to what matters.

Often the lecturer illustrates his remarks by the use of the blackboard, even of one that is so often hidden by the lectern. I feel sorry for those who have no facility in that direction. Many of us have sat at the back of the room and seen the lecturer pass his hand over the board with very little visible trace. Blackboard writing, like legends on lantern slides, should be big and bold.

Epilogue

As is not unusual with lecturers I have exceeded the usual time, and I know that the mind cannot absorb longer than the seat can endure. I trust you will share my view that our methods of presenting metallurgical information deserve the care, maintenance, and precision that we give to our other tools, be they microscopes, machines, melting furnaces, or mills. Words, as I have said, are the tools we use most, and they deserve the workmanlike finish that we seek in our metallurgical products. It is good to know something of metallurgy; it needs words and pictures to make it serve our day and generation effectively. Our success is judged by the way in which our work is presented.

Spectrochemical Analysis

BRINGING up to date the first compilation of emission spectrochemical methods published by A.S.T.M. in 1953, the second edition of "Methods for Emission Spectrochemical Analysis" has recently been published. It covers the spectrochemical analysis of the most important ferrous and non-ferrous metals and alloys, as well as several non-metallic materials such as slags, ceramics, caustic liquor, petroleum products, etc. Suggested practices are included on the installation and safe operation of a laboratory, specifying excitation sources, designating shapes and sizes of electrodes, sampling and computations. Over 800 spectral line pairs, which have been tested in continuous laboratory applications, are given.

In addition to the 65 suggested practices and methods, there are 16 recommended practices and tentative methods. Each of the methods follows the same form of presentation, so that similar steps in different procedures will be found in corresponding labelled sections under each method. Particular emphasis has been placed on specifying spectral exposure conditions, excitation conditions, and analytical pair data.

Copies may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at $7 each.

Research Progress—*continued from page* 133

alloys. The effect of increased stress is thus presumably to cause fracture to occur with less liquid present.

The material containing 0·05 per cent cadmium, under a stress of 2,000 gm/cm^2, gave separation 0·7°C. below the melting point of tin, which is precisely the estimated difference between the solidus temperature of the alloy and the tin melting point. The 0·04 per cent antimony alloy, however, also stressed at 2,000 gm/cm^2, gave a temperature of separation 0·02°C. above the melting point of tin, the solidus temperature being estimated to be 0·05°C. above this latter melting point. The apparent discrepancy is, unfortunately, within the stated experimental error for these tests.

Weinberg and Teghtsoonian draw several conclusions from their results, the more important of which are that the melting point of the boundary material in high purity tin is the same as that of the bulk material within an experimental error of 0·02°C., and that preferential melting occurs at the boundaries, provided the orientation angle across the boundary is more than a critical amount. They also suggest that impurities affect the melting behaviour of the boundaries, basing this claim on the differences observed in two samples of tin, the more impure of which contained only 0·004 per cent of impurities. The results obtained on material containing additions of lead, cadmium or antimony do not appear fully to support their views on the influence of impurities and, indeed, so far as antimony is concerned their ideas lead to the conclusion that grain boundaries in bicrystals of this alloy are depleted in antimony with respect to the bulk material. Although this may be correct it seems more likely that the authors' views on impurity effects are erroneous.

Reference

[1] F. Weinberg and E. Teghtsoonian; *Acta Metallurgica*, 1957 5 (8), 455.

Industrial News *Home and Overseas*

A Removal

We are informed by **Burdon and Miles Limited** that their new address is the Cadmore Industrial Estate, Windmill Lane, Cheshunt, Waltham Cross, Herts., and the telephone number—Waltham Cross 3184.

Luncheon Meeting

Continuing their series of luncheon meetings, the next meeting of the Birmingham branch of **The Metal Finishing Association** will be held on Tuesday, February 25 next, at the Farcroft Hotel, Rookery Road, Handsworth, Birmingham, at 12.30 p.m. The guest speaker on this occasion will be Mr. M. F. K. Fraser, M.C.

Non-Ferrous Club

Recognizing in his audience, comprised largely of members of the metal industries, an urgent need for the information he was able to give them, Mr. Norman Harper, guest speaker at the monthly luncheon of The Non-Ferrous Club, held last week at the Queens Hotel, Birmingham, took as his subject "How to Become a Millionaire." The meeting was well attended and a collection was taken on behalf of the Royal Metal Trades Pension and Benevolent Association, realizing the sum of £15 15s. 6d.

Members of the club are reminded that the annual general meeting of the club is to be held on March 19 next, and nominations for the five vacancies on the committee should reach the secretary not later than March 5.

Long Service

At the Station Hotel, Dudley, last week, four employees of **Northern Aluminium Company Limited,** at their Handsworth works, Birmingham, were entertained to a dinner celebrating their completion of 25 years' service with the company. They were: Mr. C. T. Gray, milling machine operator; Mr. G. Lane, of the pattern shop; Mr. T. Price, core shop foreman; and Mr. T. Watson, heat-treatment chargehand.

Mr. L. Fletcher, works manager, who presided over the function, welcomed Mr. C. P. Paton and Mr. B. W. H. Thornely, directors, and Mr. J. H. Mayes, general sales manager, on behalf of the assembled company, which included 39 employees who had each completed over 25 years' service and members of the senior staff.

Harwell Equipment

It is interesting to learn from **The "Solus" Electronic Tubes Ltd.** that one of the fast neutron counters manufactured by the firm is installed in the Harwell "Zeta" equipment. The tube, which is one of the Solus TV.701 FN2/12 type, is used to measure the biological hazard of any neutron emanation from the apparatus, and is installed in the control room.

Cheaper Abrasive Wheels

Introduction of an improved and lower-priced "P.G." wheel was recently announced by the **Minnesota Mining and Manufacturing Company Ltd.** Substantial reductions in polishing costs have already been claimed for the "P.G." wheel, and now even further savings are forecast for the much improved version, and prices are down in some cases by as much as 50 per cent.

Like its predecessor, the wheel consists of numerous leaves of either "Three-M-Ite" cloth or "Three-M-Ite" resin bond cloth, and is available in sizes ranging from 6 in. to 16 in. in diameter and from 1 in. to 6 in. in width. The wheel is self-conforming to the shape of any article being polished, retaining this shape throughout its working life and exposing fresh grain as it wears. In this way it eliminates costly machine down-time for wheel exchange and re-dressing.

Discussion on Plating Topics

A "Practical Platers' Night" has been organized by the London branch of the **Institute of Metal Finishing,** to take place on Friday, February 28 next. The venue is the Constitutional Club, Northumberland Avenue, London, W.C.2, and the meeting is timed to commence at 6.30 p.m. The chair will be taken by Mr. E. A. Ollard, and the occasion, which combines the opportunity for down-to-earth practical discussion of plating topics with an enjoyable social atmosphere, has proved to be an extremely popular feature of the branch programme.

B.I.C.C. News

It has been announced by British Insulated Callender's Construction Company Ltd. that the address of their Glasgow office is now 110a Maxwell Avenue, Westerton, Bearsden, Glasgow, with the telephone numbers of Bearsden 2382-3.

An additional exchange line has been connected at the Aberdeen branch office of British Insulated Callender's Cables Ltd., and the new telephone numbers are Aberdeen 53351-2.

Polish Copper Prospects

Large seams of copper have been mapped out in Poland in the regions of Boleslawov and Zlotoryja, as well as on the border of the Wroclaw and Zielona Gora Voivodships. Intensive work on the exploitation of copper ore resources is now being carried on so as to limit exports, P.A.P., the Polish news agency, reports. The rate of development at the Konrad mine, Wroclaw Voivodship, will increase considerably this year. After expansion has been completed, the mine will produce more than a million tons of copper ore yearly. The Nowy Kosoiol copper mine in the same area is being expanded. Output of this mine is scheduled to attain some 400,000 tons per year by 1960. Shaft sinking work is being carried out at a new copper mine called Lubichow, in the neighbourhood of Boleslawiec, Wroclaw Voivodship. The new mine will start producing in 1960.

Meanwhile, prospecting is being continued apace, and deposits found in the region of Sieroszowice and Lubin (Wroclaw Voivodship) have assayed an average copper content of 1·4 per cent. This ore is richer than that in the copper mines now exploited in Poland. Drilling results show that the deposits of ore cover an area 22 kilometres long and 6 kilometres wide. The ore is at a depth of 600 metres and the thickness of the layers is about 225 centimetres. The deposits contain not only copper, but also other metals such as zinc, lead, silver, vanadium, as well as small quantities of cobalt and molybdenum. "Over a dozen" drilling rigs have now been set up in the region of Sieroszowice and Lubin for further prospecting work.

At Harwell

Further interesting news about "Zeta" is that this latest development at Harwell uses a modified Radyne C.21 electronic heater, made by **Radio Heaters Ltd.,** to provide the radio frequency voltage necessary initially to ionize heavy hydrogen gas. Once the gas is ionized by this equipment it immediately forms itself into an electrically conducting ring, which acts as a short circuit secondary winding on a special form of large transformer.

Copper Wire for Portugal

The Portuguese foreign trade authorities have announced an import quota of 2 million escudos' worth of coated copper wire, corresponding to the first half of the current year.

New Casting Plant

It is reported from Madrid that a light alloy casting plant is to be set up at Corella, in the Province of Navarre, at a cost of some 9·5 million pesetas. Equipment and raw materials will be of domestic origin.

Atomic Energy Exhibition

Early announcement is made of the second International Exhibition of the Peaceful Uses of Atomic Energy, under the title of **Atoms for Peace.** This exhibition is to be held next September, from the 1st to the 14th, at Geneva during the United Nations Atomic Energy Conference. Specialized industries from the following countries are stated to be taking part—U.S.A., France, United Kingdom, Germany, Holland, Belgium, Italy, Switzerland, and U.S.S.R. Full particulars may be obtained from the Secretariat General, Place Du Lac, 1, Geneva.

Russian Aluminium

An application by the Aluminum Company of Canada to the Board of Trade to impose an anti-dumping duty against Russian aluminium has been considered by the **Aluminium Industry Council,** which also discussed the attitude which British manufacturers and users of aluminium should take. It is understood that the Council has decided not to oppose the application, although this decision was not unanimous. It would appear that users and fabricators of 80 per cent of the primary aluminium deliveries of the U.K. in 1957 were in favour of not opposing the application, while only five per cent were definitely against such a course.

Bronze and Brass Founders

Members of the **Association of Bronze and Brass Founders** in the Lancashire and Cheshire area have been given notice of a meeting to be held at the Midland Hotel, Manchester, on Tuesday, March 4 next, commencing at 11.45 a.m. At this meeting it is proposed to report and discuss current activities of the association, and, following lunch, there will be

a discussion of the "Survey of Furnaces for Melting Copper Alloys, with Cost Data Compiled under Production Conditions in Sand Foundries."

A Purchase

It has been announced by **George Cohen, Sons and Co. Ltd.** that they have purchased the whole of the machine tool plant which has become available following the decision of Associated Commercial Vehicles Ltd. to close down the works of Crossley Motors Ltd., at Stockport.

Photo-Electric Cell

A new type of photo-electric cell which, the makers say, will enable the cost of many industrial control and detection devices to be reduced substantially has recently been introduced by **Mullard Ltd.** This new cell incorporates a specially-constructed photo-sensitive element of cadmium sulphide, and is remarkable for its extremely high sensitivity.

It is stated that this cell offers particular advantage in flame-failure detectors for oil-fired burners, since its spectral response is greatest in the yellow/red region. Potential applications for the cell are, however, considered to be extremely widespread, ranging virtually over the entire fields of industry, commerce, lighting control, industrial counting processes, smoke monitoring, warning systems and safety control devices. A comprehensive range of cadmium sulphide cells will, in due course, be marketed by the company's communications and industrial valve department.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 16,454 tons, comprising London 5,510, Liverpool 10,014, and Hull 930 tons.

Copper stocks totalled 19,855 tons, and comprised London 11,222, Liverpool 6,758, Birmingham 1,175, Manchester 25, Swansea 425, and Hull 250 tons.

Tin Buffer Stock Fund

According to news from Kuala Lumpur, the Malayan Government has announced its full agreement to the creation of a special fund to be put at the disposal of the Manager of the International Tin Council's Buffer Stock. The fund would enable the Manager to buy up more surplus tin on the world market in an effort to stabilize the price of the metal. (At the last meeting of the International Tin Council, held in London, participating producing countries unanimously agreed to recommend to their Governments the setting up of a special fund to be placed at the disposal of the Buffer Stock Manager.)

In an official announcement, the Government said Malaya also pledged herself to support all measures taken by the International Tin Council to maintain the effective operation of the International Tin Agreement. The statement said both the European and Asian sections of the Malayan tin industry supported the I.T.A. Sir Douglas Waring, head of the country's biggest tin group — Anglo-Oriental (Malaya)—said that the industry was one hundred per cent behind the recommendation. Welcoming the idea, a leading Chinese miner said the price must be maintained or the whole industry would collapse. A Government spokesman said the long pipe line had to be cleared before export control could be effective, and the fund would support the machinery of the control.

Meanwhile, in London, the agreement by the Government of Malaya to the creation of the special fund to be set up by the six tin-producing countries has been communicated to the International Tin Council and has been greeted with satisfaction by its members. It is the first response to come from a producing country since the Council decided at its last meeting to endorse the recommendation for a special fund by those six countries.

A well-informed source said that the representatives from the producing countries met in London last week and had "fruitful discussions." The source added that the new fund to be set up was something as important and significant as a new agreement. The Council had been trying to achieve in a matter of months what had previously taken years to negotiate. The new fund was a "pretty big thing," particularly as Governments—including the consumer countries—had already had to find the money with which the Buffer Stock had bought 25,000 tons of tin within the last few months.

Eire Lead and Zinc

It is learned from Dublin that the Abbeytown Mining Co. Ltd., at Ballisodare, County Sligo, may have to cease production at their lead and zinc mines in Abbeytown. The manager, Mr. G. B. McKenzie, told Comtelburo that the enterprise was no longer paying its way owing to the fall in the world price of lead. He refused to confirm or to deny rumours that the mines were about to close down. He stated that the deposits were by no means exhausted, but the world prices of metals had declined to the point where it was uneconomic to mine them. About 70 workers were employed at the Abbeytown mines. Last week it was learned that the Silvermines Lead and Zinc Company Ltd., of Shallee, County Tipperary, had ceased production because of the low price of lead. Exploratory work is, however, to be continued at the mines.

More Scientists

Speaking in Birmingham last week-end, Mr. Geoffrey Lloyd, Minister of Education, said that the Government plans to increase the output of scientists and technologists from 11,700 in 1956 to about 20,000 in the later 1960s. A correspondingly large increase in supporting technicians is also planned.

The Minister also said that the Government had authorized a £100 million programme for technical college buildings and equipment, to be put in hand by 1961. He added that in 1957 new work on buildings to the value of £11 million had been commenced, which was some £5 million more than the amount spent in the previous year.

Mining and Metallurgy

An ordinary general meeting of the **Institution of Mining and Metallurgy** will be held on Thursday next, February 20, at 5 p.m. in the rooms of the Geological Society, Burlington House, Piccadilly, London, W.1. Several Papers will be submitted for discussion.

Change of Name

In future, the Self-Priming Pump and Engineering Co. Ltd., of Slough, Bucks., will be known as **SPE Co. Ltd.**, aeronautical, electrical, mechanical, and hydraulic engineers. The company's London office is now at 20-26 Lamb's Conduit Street, W.C.1.

French Aluminium

It is reported from Paris that France's output of aluminium in 1957 amounted to 159,831 metric tons, against 149,474 tons in 1956. The major part was turned out by Péchinéy, who produced 131,931 tons against 127,289 tons in the preceding year. Péchinéy-Uginé's output at the Cameroon plant was 7,539 tons.

Research Company

One of the latest steps in the Pena Industries' plan for providing a complete service to industry is the formation of the **Penco Research and Development Company Ltd.** This new company is a natural progression in the expansion of the parent company, with its varied interests in electronics, metals and plastics. The new company will co-ordinate engineering developments and design within the Pena group. Laboratory facilities for research and advanced studies will also be available to other companies.

Appointed managing director of the new company is Mr. Alexander Rubach, who has had long and varied experience in electronics. Before joining Pena, he was head of the experimental engineering department at the G.E.C. applied electronics laboratories at Stanmore, Middx.

Welding Aids

At the Kent refinery of the British Petroleum Co. Ltd. extensions are now being built, at an estimated cost of £30 million, which will increase capacity by about 2½ million tons of oil per year. Erection of tankage on the site is being handled by the Motherwell Bridge and Engineering Company Ltd., and a large proportion of the circumferential welding of tanks is being carried out with the aid of two Quasi-Arc Pandjiris girth welders.

This machine consists of two Unionmelt D.S.H. welding heads with control panels and platforms for the two operators. These are mounted on a saddle-type carriage which straddles the upper strake of the joint which is to be welded. To provide welding power sources, a total of 75 Quasi-Arc MCR.375 rectifier sets is being used. The machines are used to supply current for manual welding with E6010, E6012, E6013, and stainless electrodes.

News from Birlec

What is described as the first mains frequency coreless induction furnace in the world to be engaged in the production of high-speed steel has been recently installed by **Birlec Limited** at the Sheffield works of Inca Steel Company Ltd., a member of the C. R. Denton Steel and Tool Company Ltd. group of companies.

Similar Birlec furnaces are already widely used in non-ferrous and iron foundries, but this new installation is, we understand, the first example to be used by a British steel maker for the production of alloy steel. This furnace has a capacity of 1½ tons, and a power input of 450 kW can be applied, giving a maximum output of the order of ½ ton/hr. of prime high-speed steel ingots. Flexible power input control enables metal temperature to be closely adjusted.

Acheson Prospects

In the fourth number of "Prospects," the journal of **Acheson Colloids Ltd.**, is a lead story which deals comprehensively

with the development of a special conducting ink for postage stamps, an Acheson product which, we understand, is playing an important part in the G.P.O.'s mechanization plans.

Other successful applications for "dag" products described in this magazine concern the "built-in" lubrication of Remington typewriter parts, the dry-film treatment of magnets, and the use of "Aquadag" colloidal graphite in water on a patent fluorescent lamp.

Two-Day Exhibition

Readers in the Midlands area will be interested in an exhibition which is being held in the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, on Tuesday and Wednesday of next week. Provided by **Unicam Instruments Limited,** the Unicam S.P.900 flame spectrophotometer will be demonstrated for the first time in this area. It is said to be of particular interest to metallurgists and chemists, and is very compact in layout and simple to operate. On the first day the exhibition will be open from 2 p.m. until 8.30 p.m., and on the second day from 9 a.m. to 5 p.m.

A Birmingham Lecture

On Tuesday, February 25 next, at 7 p.m., Dr. I. G. Slater, Ph.D., M.Sc., F.I.M., C.I.Mech.E., is to give a lecture on **"Improving Productivity in Foundry Work,"** at the Byng Kendrick Suite, College of Technology, Birmingham. The chair at this meeting will be taken by Mr. W. A. Bannister, director of C. and L. Hill Ltd.

Invitations to this lecture are extended by the Association of Bronze and Brass Founders and the Birmingham Productivity Association. Dr. Slater is the head of the Department of Metallurgy at the Birmingham College of Technology, and was formerly director of operational research at the Admiralty.

Men and Metals

Several new appointments have been announced by the United Kingdom Atomic Energy Authority. **Mr. J. C. C. Stewart,** formerly director of technical policy in the Industrial Group at Risley, becomes a deputy managing director of the Group. **Mr. J. B. W. Cunningham,** formerly deputy director (Civil Reactors), is appointed director of Industrial Power in the Group. **Dr. R. Hurst,** previously chief chemist in the Research and Development branch of the Industrial Group at Risley, becomes director of the Dounreay Experimental Reactor Establishment. **Mr. D. S. Mitchell,** formerly director of Administration, is to be director of Personnel and Administration in the Industrial Group. **Mr. D. W. Fry,** chief physicist at Harwell, has been appointed a deputy director of the Atomic Energy Research Establishment.

It is announced that **Mr. F. J. Clark** has relinquished his appointments with the British Oxygen group of companies.

An announcement of interest to the Midlands last week was that **Councillor E. N. Hiley** is to be the next Mayor of

Solihull, Warwickshire. A councillor since 1947, Mr. Hiley is probably better known to industry as the secretary of the National Brassfoundry Association. It was in 1941 that he was appointed secretary of the then Birmingham Brassfounders Employers' Association, which in 1944 developed into the present national association. Mr. Hiley was awarded the M.B.E. in 1950.

An additional technical representative has been appointed by Martonair Limited. **Mr. S. Teasdale** will represent the company in the North-West in an area enclosed by Chester, Crewe and Oldham.

In the issue of this journal for January 31 under this heading, some details were given of changes which had been announced in the board of The Pyrene Company Limited, and connected with their Metal Finishng Division. Reference was made to Mr. H. F. Marshall who has now taken over board responsibility for this division. Our reference, of course, should have read **Mr. H. F. Parshall,** M.A., and we regret having made this error in our original announcement.

In succession to the late Capt. G. W. Dobson, **Mr. J. S. Cadman** has been appointed chairman of Cowlishaw Walker and Company Limited. Mr. Cadman is also managing director of the company.

As a result of the merging of the copper refining activities of the Delta Metal group with those of Elkington Copper Refiners Limited, it is understood that **Mr. A. F. Thomas,** a director of the Delta company, and **Dr. F. M. Pinoff,** a director of Copper and Alloys Limited, have joined the board of the Elkington company.

In order to concentrate under one director all matters relating to the steering-gear division of George Kent Limited, that company has appointed **Mr. L. A. C. Bartlett,** A.M.I.Mech.E., to take the overall supervision of this division under his charge. **Mr. R. S. Medlock,** B.Sc., A.R.I.C., A.M.I.Mech.E., A.M.I.E.E., has been appointed technical and home sales director. **Mr. E. E. Cook,** M.Inst.F., formerly home sales manager, is leaving for Australia, where he will take charge of the company's central organization which is being formed there. **Mr. J. Tham** takes over the position of home sales manager. **Mr. K. Scanes,** previously exhibitions manager, will be responsible for relations with overseas subsidiary companies, and **Mr. W. G. Askew,** publicity manager, assumes responsibility for the exhibitions department. The company also announces that **Mr. W. T. H. Carter** has been appointed chief buyer for the instrument division.

Forthcoming Meetings

February 15 — Non-Destructive Testing Society of Great Britain. Birmingham Branch. Exchange and Engineering Centre, Stephenson Place, Birmingham, 2. "Non-Destructive Testing in Heavy Industry." M. R. Piercey. 10.30 a.m.

February 17—Institute of Metal Finishing. London Branch. (Joint Meeting with Organic Finishing Group.) Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1. "Health Hazards Associated with Metals Affecting the Finisher." A. R. Thompson. 6.30 p.m.

February 17 — Institution of Production Engineers. Manchester Section. The Reynolds Hall, Manchester College of Science and Technology, Sackville Street, Manchester. "Metal Cutting Lubricants and Coolants." D. A. Wight. 7.15 p.m.

February 17 — Institution of Production Engineers. Coventry Section. Craven Arms, High Street, Coventry. "Spark Erosion." Herr Ullmann. 7.15 p.m.

February 18 — Institution of Production Engineers. Peterborough Section. The Conference Room, Peterscourt, Peterborough. "Electric Welding." J. W. Wright. 7.30 p.m.

February 18 — Institute of British Foundrymen. East Anglian Section. Lecture Hall, Public Library, Ipswich. "Mechanization of a Small Jobbing Foundry." R. Blandy. 7.30 p.m.

February 18—Institute of Metal Finishing. South-West Branch. Grand Hotel, Bristol. "Modern Painting and Stoving Techniques." J. J. Stordy. 7 p.m.

February 19—Institute of Metal Finishing. Organic Finishing Group. Exchange and Engineering Centre, Stephenson Place, Birmingham. "Fire Hazards in Organic Finishing and Their Avoidance." L. A. Smith. 6.30 p.m.

February 20—Institute of Metals. Birmingham Local Section. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham. "Neutron Irradiation Effects in Metals." J. G. Ball. 6.30 p.m.

February 20 — Institution of Production Engineers. Northern Ireland Section. The Kensington Hotel, Belfast. "Machining Techniques for Non-Ferrous Materials." S. Radcliffe. 7.30 p.m.

February 20 — Institution of Production Engineers. London Section. Royal Empire Society, Northumberland Ave., Strand, London, W.C.2. "Research on Modern Metal-Cutting Techniques." J. Cherry. 7 p.m.

Metal Market News

MARKETS were relatively steady last week but prices showed an inclination to ease off towards the end of the period under review, and copper, at any rate, closed well below the best level reached. Wall Street was, on the whole, steadier, but the overall American position shows no improvement and comment in the United States is not by any means cheerful. There is, in fact, no evidence that the recession in that country has as yet touched bottom, and it certainly seems as though things are destined to be worse before they are better. Here, in the U.K., there has almost certainly been some decline and, as will be seen from the figures quoted below, copper consumption dropped rather sharply in December. The standard market last week closed 5s. up for cash at £164, while three months was unchanged at £165 5s. 0d., the turnover being about 8,200 tons. Stocks in L.M.E. warehouses dropped by 50 tons to 19,755 tons. At the end of the week the Belgian price was dropped by 25 points to Belgian francs 23·50 per kilo, and one custom smelter, at any rate, was rumoured to be offering at 23·50 cents. No change was made by the domestic producers, who maintained their price at 25 cents despite some idea that there would be a reduction to 24 cents. Interest is now centred a good deal on the possibility of a duty being imposed on copper entering the United States, but for this to happen the price must stand at 24 cents or lower for a complete calendar month. In any case, it may be assumed that July 1 will see the return of a duty at just under 2 cents per lb.

Advance statistics for the month of December, issued by the British Bureau of Non-Ferrous Metal Statistics, show that consumption of copper in the U.K. during that month fell short of November by 7,000 tons. During the last month of the year usage of copper in all forms, i.e. scrap and refined metal, amounted to 48,600 tons, whereas in November it was 55,600 tons. October was given as 60,000 tons, so that throughout the last quarter of the year consumption was falling away. The fourth quarter total was 164,300 tons, of which some 32,500 tons comprised scrap. Last year saw total consumption of 641,500 tons, of which 507,500 tons were in the form of refined metal, the balance being scrap. The 1956 total was 633,100 tons. There were 91,500 tons of stock on hand at the year end, which was about 10,000 tons up on November. Details of world stocks and of the tonnage on hand in the U.S.A. at January 31 are not available as we write, but it is fairly generally assumed that there will be an increase over December.

Last Friday saw the appearance of the newly-constituted producers' average price for electro copper, but this did not excite any special comment. How things will develop in due course it is very hard to say. As to the other metals, tin closed £3 10s. 0d. down for cash at £730 10s. 0d., with three months £4 off at £729 10s. 0d. The turnover was 1,120 tons and on the whole sentiment is rather brighter. Lead put on 17s. 6d. for February and 7s. 6d. for May, both positions standing at £73 12s. 6d. The turnover was 5,600 tons, while in zinc some 8,100 tons changed hands. In that metal prompt was up by 25s. and forward by 27s. 6d., the closing prices being £65 10s. 0d. and £64 12s. 6d. for the respective positions. The firmness of the zinc quotation has been quite a feature of the market during the past few days, and, by the same token, there is a fairly stiff backwardation in existence amounting at the close of business last Friday to 17s. 6d. This would appear to suggest a modest squeeze for the prompt position.

Birmingham

Little change has taken place in the Midland industrial area. The building industry is short of work and the recent severe weather conditions has accentuated the difficulties. Consequently, orders for builders' supplies, in both ferrous and non-ferrous materials, are difficult to obtain. The edge tool trade maintains a fair level of business, much of it in the overseas markets. Competition from foreign producers is keen, and expansion is also hampered by import restrictions and financial barriers. The activity in the motor trade is maintained, and the recent labour difficulties have been smoothed out. Valuable export business has been booked and will ensure full employment for a long way ahead.

In the iron and steel industry there are indications of some slackness, particularly in the re-rolling mills and amongst foundries making builders' castings. On the other hand, sheet mills are working to capacity, and a big proportion of the output is for the motor trade. Pressure for heavy steel plates is maintained. Substantial tonnages of heavy joists and sections are being delivered to building sites, though new contracts are fewer because of restrictions on capital expenditure. Work in the engineering industries is responsible for much activity in the foundries making heavy castings.

New York

Copper continued depressed during the past week in the U.S. Tin was mixed, while lead and zinc were moderately better. Leading copper sources said that copper curtailment programmes recently announced here and abroad had failed thus far to stimulate consumer buying interest. Custom smelters reported, at best, spotty sales of electrolytic copper at 24 cents a lb., while producers reported little improvement in fabricator buying for February shipment at the 25 cent price. Dealers were reported to be offering copper at around 23¼ cents per lb. with buyers laggard.

Industry sources said that cutbacks recently made by Phelps Dodge, Kennecott Copper at three of its U.S. mines, and Union Miniere, were steps in the right direction to bring output in line with demand. They noted, however, that it would take about 90 days before cutbacks at the mines were reflected in lower refined production. These copper sources added that there was a question whether the Anglo-American Corporation announcement of a ten per cent curtailment at its African mines would result in a cutback in output or merely calling a halt to further increases.

One leading lead and zinc producer source said the best information available indicated that the G.S.A. would be buying lead and zinc for the stockpile until end-March at least. He said the G.S.A. had been acquiring about 10,000 tons of zinc and 6,000 to 7,000 tons of lead monthly. This source said that with the domestic lead-zinc producers clamouring for relief and a strong Congressional bloc pushing for remedial action, he looked for some tariff relief by the end of March or a continuation of some form of stockpile buying.

Tin, after earlier steadiness on modest dealer buying, turned softer as London declined. Consumer interest in this market was lacking.

Latest news from New York is that copper custom smelters are now quoting 23·50 cents per lb. delivered Connecticut Valley, against 24·00 cents previously. In commemoration of Abraham Lincoln's birthday, the New York Metal Exchange was closed on Wednesday last.

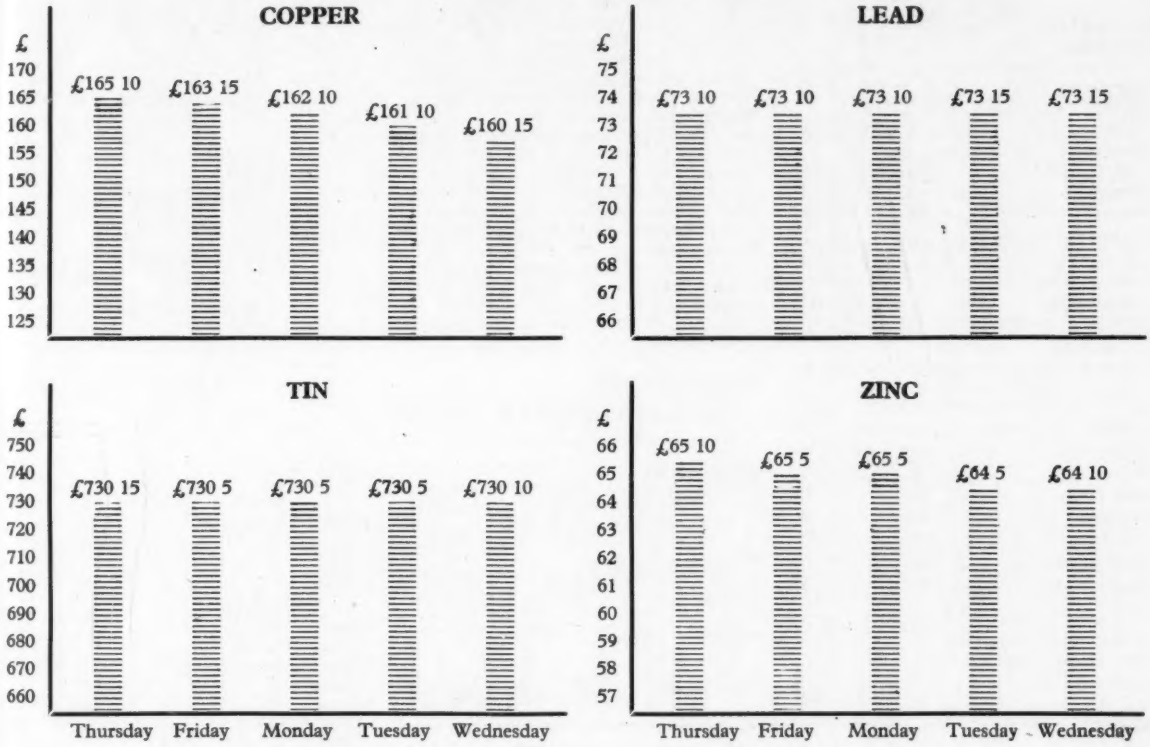
India

Recent reports from New Delhi state that the Indian Government has abolished the export duty on manganese ore in which the manganese content calculated as a percentage of the moisture-free ore is below 42 per cent.

Announcing this to take effect immediately, the Ministry of Commerce and Industry said that the Government had also decided to reduce duty on manganese ore with 42 to 44 per cent manganese content to 10 rupees per ton. Previously the duty on ore of content over 38 per cent and up to 40 per cent was 10 rupees per ton, and 40 to 44 per cent, 20 rupees per ton.

METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 6 February 1958 to Wednesday 12 February 1958



OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton	Canada c/lb ≏ £/ton	France fr/kg ≏ £/ton	Italy lire/kg ≏ £/ton	Switzerland fr/kg ≏ £/ton	United States c/lb ≏ £/ton
Aluminium		24.63 203 10	210 182 15	400 232 0	2.50 209 0	28.10 224 17 6
Antimony 99.0			195 169 12 6	430 249 10		33.00 264 0
Cadmium			1,400 1,218 0	2,800 1,624 0		155.00 1,240 0
Copper						
Crude						
Wire bars 99.9				345 200 8 6		
Electrolytic	23.00 168 2 6	24.75 202 10	220 191 10		2.20 184 0	25.00 200 0
Lead		12.25 101 2 6	123 107 0	183 106 2 6	.92 77 0	13.00 104 0
Magnesium						
Nickel		71.50 590 10	1,205 104 17 6	1,330 771 10	8.10 677 2 6	74.00 592 0
Tin	100.25 732 17 6		879 764 15	1,400 812 0	8.80 735 17 6	93.25 746 0
Zinc						
Prime western		10.00 82 12 6				10.00 80 0
High grade 99.95		10.60 87 10 0				
High grade 99.99		11.00 90 5				
Thermic			107.12 93 2 6			
Electrolytic			115.12 100 2 6	161 93 7 6	.85 71 0	11.75 94 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 12/2/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	197	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	13	18	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	160	15	0
Fire Refined 99·70%	„	159	0	0
Fire Refined 99·50%	„	158	0	0
Copper Sulphate	„	67	0	0
Germanium	grm.		3	4
Gold	oz.	12	8	10¾
Indium	„		10	0
Iridium	„	27	0	0
Lanthanum	grm.		15	0
Lead English	ton	73	15	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	73	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom	
Palladium	„	7	10	0
Platinum	„	28	10	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	4½
Tellurium	lb.		15	0
Tin	ton	730	10	0
Titanium	lb.		19	6
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	63	18	9
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	88	18	9
Granulated 99·99+%	„	105	5	0

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

		£	s.	d.
Aluminium Alloy (Virgin)				
B.S. 1490 L.M.5	ton	231	0	0
B.S. 1490 L.M.6	„	221	0	0
B.S. 1490 L.M.7	„	233	0	0
B.S. 1490 L.M.8	„	222	0	0
B.S. 1490 L.M.9	„	221	0	0
B.S. 1490 L.M.10	„	238	0	0
B.S. 1490 L.M.11	„	235	0	0
B.S. 1490 L.M.12	„	245	0	0
B.S. 1490 L.M.13	„	233	0	0
B.S. 1490 L.M.14	„	246	0	0
B.S. 1490 L.M.15	„	230	0	0
B.S. 1490 L.M.16	„	225	0	0
B.S. 1490 L.M.18	„	222	0	0
B.S. 1490 L.M.22	„	233	0	0

		£	s.	d.
†**Aluminium Alloy (Secondary)**				
B.S. 1490 L.M.1	ton	154	10	0
B.S. 1490 L.M.2	„	158	10	0
B.S. 1490 L.M.4	„	182	0	0
B.S. 1490 L.M.6	„	204	10	0
†Average selling prices for November.				
***Aluminium Bronze**				
BSS 1400 AB.1	ton	195	0	0
BSS 1400 AB.2	„	210	0	0
***Brass**				
BSS 1400-B3 65/35	„	127	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	155	0	0
(86/7/5/2)	„	166	0	0
(88/10/2/1)	„		—	
(88/10/2/½)	„	219	0	0
Manganese Bronze				
BSS 1400 HTB1	„	169	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	235	0	0
Phosphor Copper				
10%	„	202	0	0
15%	„	210	0	0
**Average prices for the last week-end.*				
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	346	0	0
Grade D Plumbers	„	280	3	0
Grade M	„	378	9	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9	„		—	
Zinc Alloys				
Mazak III	ton	98	10	0
Mazak V	„	102	10	0
Kayem	„	108	10	0
Kayem II	„	114	10	0
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			£	s.	d.
Sheet 10	S.W.G.	lb.		2	9
Sheet 18	S.W.G.	„		2	11
Sheet 24	S.W.G.	„		3	2
Strip 10	S.W.G.	„		2	9
Strip 18	S.W.G.	„		2	10
Strip 24	S.W.G.	„		2	11½
Circles 22	S.W.G.	„		3	3
Circles 18	S.W.G.	„		3	2
Circles 12	S.W.G.	„		3	1
Plate as rolled		„		2	8½
Sections		„		3	2½
Wire 10 S.W.G.		„		3	0
Tubes 1 in. o.d. 16 S.W.G.		„		4	1

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1½
Sheet 18 S.W.G.	„		3	4
Sheet 24 S.W.G.	„		3	11½
Strip 10 S.W.G.	„		3	1½
Strip 18 S.W.G.	„		3	3
Strip 24 S.W.G.	„		3	11
BS1477 HP30M. Plate as rolled			2	11½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	9½
Sheet 18 S.W.G.	„		4	1½
Sheet 24 S.W.G.	„		4	11½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	1½
Strip 24 S.W.G.	„		4	9
BS1477. HPC15WP. Plate heat treated	„		3	6½
BS1475. HG10W. Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP Tubes 1 in. o.d. 16 S.W.G.	„		5	0
BS1476. HE10WP. Sections	„		3	2
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	4½
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	202	15	0
Extruded Bar	lb.		1	7¼
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	141	0	0
Condenser Plate (Naval Brass)	„	151	0	0
Wire	lb.		2	1⅞
Bronze Sheet and Strip	ton		—	
Copper Tubes	lb.		1	7⅛
Sheet	ton	187	0	0
Strip	„	187	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	212	15	0
Cupro Nickel Tubes 70/30	lb.		3	1½
Lead Pipes (London)	ton	112	10	0
Sheets (London)	„	110	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Rods	lb.		—	
Sheet and Strip 7%	„		3	2½
Wire 10%	„		3	9¼
Phosphor Bronze Wire	„		3	4½
Titanium				
Billet	lb.	4	10	0
Sheet	„	6	12	0
Wire	„	9	10	0
Tube	„	16	0	0
Zinc Sheets, English destinations	ton	98	0	0
Strip	„		nom.	

Financial News

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for Nov., 1957, have been issued by the Ministry of Supply as follow (in long tons):—

Virgin Aluminium	
Production	2,445
Imports	22,026
Despatches to consumers	17,246
Secondary Aluminium	
Production	9,600
Virgin content of above	1,184
Despatches (including virgin content)	9,916
Secondary in Consumption (per cent)	
Wrought products	5·7
Cast products	82·2
Destructive uses (aluminium content irrecoverable)	75·1
Total consumption	29·7
Scrap	
Arisings	12,542
Estimated quantity of metal recoverable	8,727
Consumption by:	
(a) Secondary smelters	11,748
(b) Other users	1,059
Despatches of wrought and cast products	
Sheet, strip and circles	11,407
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,674
(b) Tubes (i) extruded	288
(ii) cold drawn	729
(c) (i) Wire	1,801
(ii) Hot rolled rod (not included in (c) (i)	18
Forgings	363
Castings: (a) Sand	1,891
(b) Gravity die	4,167
(c) Pressure die	1,425
Foil	2,188
Paste	303
Magnesium Fabrication	
Sheet and strip	7
Extrusions	18
Castings	218
Forgings	9

M. Mole and Son Ltd.

Dividend for 1957 raised to 20 per cent (from 17½ per cent, including a bonus of 2½ per cent for 1956). Net profits increased to £28,083 (from £21,519), after deducting tax of £32,429 (£26,646).

Price Reduction

It has been announced by Borax Consolidated Limited that, having succeeded in securing a reduction in ocean freight rates, they are able to reduce their Borax and Boric acid prices, effective February 17, by 10s. per ton. Full details may be obtained from the company.

Westinghouse Brake and Signal Co.

Speaking at the 77th annual general meeting of the company, on Monday last, Capt. A. R. S. Nutting, O.B.E., M.C., chairman, said that orders received during the 1956-57 year were greatly in excess of the previous year's record, and despatches reached an exceptionally large total. A high percentage of the company's turnover of brakes and signalling of all kinds has been directly or indirectly exported. Trading profit was £2,143,466, an increase of £410,344 over the previous year's figure. Taxation takes £1,049,340 and the net profit figure is £554,870. The board recommended a dividend of 10 per cent (less tax).

Referring to the work of the rectifier division of the company, the chairman said that in the year under review the company had attained another record output. In general, said Capt. Nutting, the current year promises well, as the orders on hand of the parent company and its subsidiaries ensure a very busy 1957-58, and it was gratifying to know that the orders from overseas presented a high percentage of those orders. Westinghouse products were being exported, directly and indirectly, to some seventy countries.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons, Limited, Company Registration Agents, Chancery Lane, W.C.2.

Atkinsons Pressings Limited (595604), Tollgate Works, Sapcote Road, Burbage, Leics. Registered December 18, 1957. To carry on business of general engineers, etc. Nominal capital, £1,000 in £1 shares. Permanent managing director: E. W. Atkinson.

Stevenson (London) Limited (595652), Finsbury Court, Finsbury Pavement, E.C.2. Registered December 18, 1957. To carry on business of metal merchants, etc. Nominal capital, £2,000 in £1 shares. Directors to be appointed by subscribers.

R. Goodwin and Company Limited (595688), Brunn Wharf, Ripple Road, Barking, Essex. Registered December 19, 1957. To carry on business of scrap metal merchants, etc. Nominal capital, £10,000 in £1 shares. Directors: R. Goodwin and W. R. Bridges.

Wilncote Castings Limited (595795), Lombard House, Great Charles Street, Birmingham, 3. Registered December 20, 1957. Nominal capital, £5,000 in £1 shares. Directors: J. Knight, H. B. Clarke and J. H. Morris.

Monyash Minerals Limited (595888), The Shaws, Snitterton Road, Matlock, Derbys. Registered December 23, 1957. To carry on surface and other mining operations, etc. Nominal capital, £1,000 in £1 shares. Directors: Rene H. Dakin and Marcel J. Dakin.

R. S. Hendrie and Son Limited (595894), 19 St. George Road, S.W.19. Registered December 23, 1957. To carry on business of waste and scrap material merchants, etc. Nominal capital, £10,000 in £1 shares. Directors: R. S. Hendrie and R. N. Hendrie.

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 11/2/58.

	£
Aluminium	
New Cuttings	160
Old Rolled	130
Segregated Turnings	100
Brass	
Cuttings	110
Rod Ends	104
Heavy Yellow	85
Light	80
Rolled	102
Collected Scrap	83
Turnings	98
Copper	
Wire	136
Firebox, cut up	136
Heavy	130
Light	125
Cuttings	136
Turnings	119
Braziery	110
Gunmetal	
Gear Wheels	140
Admiralty	140
Commercial	115
Turnings	110
Lead	
Scrap	65
Nickel	
Cuttings	—
Anodes	530
Phosphor Bronze	
Scrap	115
Turnings	110
Zinc	
Remelted	55
Cuttings	43
Old Zinc	30

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£148.0.6)	170
Heavy copper	(£148.0.0)	170
Light copper	(£121.17.6)	140
Heavy brass	(£95.15.0)	110
Light brass	(£65.5.0)	75
Soft lead scrap	(£52.5.0)	60
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£82.12.6)	95
France (francs per kilo):		
Copper	(£187.0.0)	215
Heavy copper	(£187.0.0)	215
Light brass	(£134.17.6)	155
Zinc castings	(£67.0.0)	77
Tin	(£565.10.0)	650
Aluminium pans (98½ per cent)	(£139.5.0)	160
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£104.10.0)	180
Lead, soft, first quality	(£88.15.0)	153
Lead, battery plates	(£53.7.6)	92
Copper, first grade	(£162.10.0)	280
Copper, second grade	(£148.0.0)	255
Bronze, first quality machinery	(£168.5.0)	290
Bronze, commercial gunmetal	(£139.5.9)	240
Brass, heavy	(£110.5.0)	190
Brass, light	(£101.10.0)	175
Brass, bar turnings	(£116.0.0)	200
New zinc sheet clippings	(£58.0.0)	100
Old zinc	(£43.10.0)	75

THE STOCK EXCHANGE

Steels Depressed And Industrial Markets Generally Uncertain In Tone

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 11 FEBRUARY	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	19/6		10	10	10 5 3	19/9	19/1½	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6		8½	7½	11 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	48/6	—1/6	15	15	6 3 9	50/–	47/6	72/3	47/9
1,590,000	1	Birfield Industries	52/–	—6d.	15	20N	5 15 6	53/9	51/9	70/–	48/9
3,196,667	1	Birmid Industries	57/3		17½	17½	6 2 3	57/9	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	25/6	—3d.	10	8	7 16 9	26/7½	25/6	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/–		5	5	6 13 3	—		16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/6		6	6	7 5 6	17/–	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	28/9		12½	12½	8 14 0	—		30/3	28/9
300,000	1	Ditto Pref. 5%	15/3		5	5	6 11 3	—		16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/–		7	7	7 7 3	—		22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	44/–	—9d.	12	12	5 9 0	44/9	41/3	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/3		6	6	6 4 9	19/3	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	42/–		12½	12½	5 19 0	42/–	38/10½	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	29/9	+3d.	10	15N	6 14 6	32/3	29/1½	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	20/7½	+1½d.	25	25	6 2 0	20/7½	20/1½	24/6	19/3
60,484	1/–	Carr (Chas.)	2/–		25	25	12 10 0	2/3	2/–	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/6		25	25	11 2 3	4/9	4/4	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	16/–	—4½d.	10	15N	12 10 0	16/6	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/10½		6	6	7 11 3	—		17/6	16/–
250,000	2/–	Coley Metals	4/–	—6d.	25	25	12 10 0	4/6	4/–	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	46/9	—1/–	22½	22½	10 1 3	51/6	46/9	92/6	49/–
1,136,233	1	Davy & United	48/–		15	12½	6 5 0	48/–	46/3	60/6	42/6
2,750,000	5/–	Delta Metal	20/4½	—3d.	•17½	•17½	4 6 0	21/4½	19/9	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	26/6		15B	22½	9 8 9	26/6	24/–	38/6	25/–
500,000	1	Evered & Co.	41/3		15	15	7 5 6	41/3	41/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	31/6	—2/1½	12½	14	Y7 6 0	38/7½	31/6	59/–	38/–
1,250,000	Stk. (10/–)	General Refractories Ltd.	28/–	+6d.	17½	17½	6 5 0	28/3	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	64/–		15	12	4 13 9	64/–	64/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	5/9		11½	11½	10 0 0	6/–	5/7½	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	13/–		20	20	7 13 9	13/1½	12/10½	18/–	12/6
3,614,032	10/–	Goodlass Wall & Lead Industries ...	28/3	—9d.	18	16	6 7 6	29/9	28/3	37/3	28/9
342,195	1	Greenwood & Batley	46/10½		17½	17½	7 9 3	—		50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	11/6		•15	•30‡	6 10 6	—		16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9		7	7	7 9 3	—		22/3	18/7½
1,075,167	5/–	Heenan Group	7/7½	+3d.	10	20‡	6 11 3	7/7½	6/9	10/4½	6/9
142,045,750	Stk. (£1)	Imperial Chemical Industries ...	38/7½	—1/3	10	10	5 3 6	39/10½	37/6	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	17/–		5	5	5 18 0	17/1½	16/–	18/6	15/6
14,584,025	••	International Nickel	141½	—2½	$3.75	$3.75	4 15 0	144	136½	222	130
430,000	5/–	Janks (E. P.), Ltd.	15/6	+3d.	27½ ϕ	27½	8 17 6	15/7½	14/6	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	15/–		5	5	6 13 3	—		17/–	14/6
3,987,435	1	Ditto Ord.	39/6	—6d.	10	9	5 1 3	41/3	39/6	58/9	40/–
600,000	10/–	Keith, Blackman	16/3		15	15	9 4 6	16/3	15/–	21/9	15/–
160,000	4/–	London Aluminium	4/1½		10	5	9 14 0	4/3	3/10½	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord....	41/9	+6d.	12½	12½	5 19 9	41/9	40/6	54/6	41/–
400,000	1	Ditto Pref.	22/9		7½	7½	6 11 9	—		25/3	21/9
765,012	1	McKechnie Brothers Ord.	35/–		15	15	8 11 6	—		48/9	37/6
1,530,024	1	Ditto A Ord.	32/6		15	15	9 4 6	—		47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	9/3		27½‡	25	7 8 9	9/6	9/–	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	5/9		7½	7½	7 16 6	—		6/6	5/–
13,098,855	Stk. (£1)	Metal Box	43/6	—3d.	20‡	15M	4 12 0	43/9	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	6/3		50	50	16 0 0	6/6	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	22/9		10	10	8 15 9	22/9	22/9	25/–	21/6
80,000	5	Ditto Pref. 6%	83/6		6	6	7 3 9	—		90/6	83/6
3,064,930	Stk. (£1)	Morgan Crucible A	35/6		10	11	5 12 9	36/6	35/1½	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/3		5½	5½	6 7 6	17/3	17/–	19/3	16/–
2,200,000	Stk. (£1)	Murex	55/–		20	20	7 5 6	57/6	54/10½	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	7/–		10	10	7 2 9	7/–	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	27/–	+6d.	27½D	27½	6 15 9	27/–	26/–	41/–	24/9
1,365,000	Stk. (5/–)	Serck Radiators	11/7½	+1½d.	17½Z	15	5 0 3	12/–	11/1½	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	43/9		16	16	7 6 6	—		57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	20/–		6½	6½	6 10 0	—		21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	50/–	—1/9	15	15	6 0 0	53/9	50/–	70/9	50/6
41,000,000	Stk. (£1)	Vickers	30/4½	+1½d.	10	10	6 11 9	31/–	29/4½	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 3	15/3	14/9	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/6	+1/1½	•5	•5	6 17 0A	22/6	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	73/6		20	15	5 8 9	73/6	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	36/3	+3d.	10	18P	5 10 3	36/3	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	7/6		25	40	6 13 3	7/9	7/2½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	15/3	—3d.	27½	27½	9 0 3	15/6	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/9	+1½d.	20	17½E	13 15 9	3/9½	3/7½	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	—		12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/1½	+3d.	40D	33½	8 10 9	3/1½	2/7½	5/–	2/9

•Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. ••Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. H and 200% capitalized issue. M and 10% capitalized issue. Y Calculated on 11½% dividend. ||Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share or £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And proposed 100% capitalized issue.